PB89-229546

Superfund Record of Decision (EPA Region 2) Ciba-Geigy, NJ. (First Remedial Action), April 1989

(U.S.) Environmental Protection Agency, Washington, DC

24 Apr 89

U.S. Department of Commerce
National Technical Information Service
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United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R02-89/076
April 1989

PB89-229546

EPA

Superfund Record of Decision:

Ciba-Geigy, NJ

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16. Abstract (Limit: 200 words)

The Ciba-Geigy Chemical Corporation site is located in Dover Township, Ocean County, New Jersey. The site covers 1,400 acres, 320 of which are developed; the remaining area is largely wooded. The site is bounded by industrial, commercial, residential, and recreational areas. The Toms River, which derives surface water primarily through ground water baseflow, runs through the northeast sector of the property. The aquifer system in the site area is tapped by municipal, industrial, and private wells. The manufacturing facility, presently owned by Ciba-Geigy Chemical Corporation, has been in operation since 1952 and is composed of numerous buildings, an industrial wastewater treatment plant, and a lined reservoir for emergency storage of treated and untreated wastewater. From 1952 to 1988, a variety of synthetic organic pigments, organic dyestuffs and intermediates, and epoxy resins were manufactured at the site. The company disposed of chemical wastes onsite in several locations, including a 5.2-acre drum disposal area (containing approximately 100,000 drums); a 3.9-acre lime sludge disposal area (used for disposal of inorganic wastes); a 12-acre filtercake disposal area (which received sludge from the wastewater treatment); five backfilled lagoons comprising 8.5 acres; and a calcium sulfate disposal area. The drum disposal area and lime sludge disposal area were closed and capped in 1978. About this time, the
(See Attached Sheet)

17. Document Analysis a. Descriptors
Record of Decision - Ciba-Geigy, NJ
First Remedial Action
Contaminated Media: gw
Key Contaminants: VOCs (TCE, PCE, toluene, benzene), metals (arsenic, chromium)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report) None

20. Security Class (This Page) None

21. No. of Pages 123

22. Price

(See ANSI-Z39.18)

See Instructions on Reverse

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Department of Commerce

16. Abstract (Continued)

filtercake disposal area was also closed and covered with soil. Ground water contamination is migrating from these inactive disposal sites easterly towards the Toms River. Currently, the company generates both liquid and solid wastes. The liquid wastes are treated onsite in a wastewater treatment plant before discharge to the Atlantic Ocean. The solid wastes are disposed of offsite, and sludges from the wastewater treatment plant are disposed of in a permitted, double-lined, onsite landfill. EPA began investigating the site in 1980. Throughout its operation, the facility has routinely violated treatment and disposal permits, including accepting hazardous offsite waste beginning in 1981. The landfill reportedly was leaking as early as 1981, precipitating remedial measures by the State including issuance of a consent order forcing Ciba-Geigy to close part of the landfill and monitor ground water and leachate. In 1984, after discovering that Ciba-Geigy was illegally disposing of drums containing liquids and hazardous waste in the landfill, the State ordered Ciba-Geigy to remove 14,000 drums. In 1985, leaking equalization basins associated with the wastewater treatment plant led to Ciba-Geigy closing the basins and beginning remediation of the ontaminated plume from these basins. Currently, contaminants are present in leaking drums, waste sludges, soils, and ground water. This Record of Decision addresses the first operable unit focusing on the remediation of ground water contamination in the upper aquifer. Remediation of the onsite source areas and deeper aquifer (if needed) will be addressed in future operable units. The primary contaminants of concern affecting the ground water are VOCs including benzene, PCE, TCE, and toluene; and metals including arsenic and chromium.

The selected remedial action for this site includes sealing contaminated residential irrigation wells; on- and offsite ground water pumping with onsite treatment using filtration, reverse osmosis, and GAC in an upgraded version of the Ciba-Geigy wastewater treatment plant, followed by temporarily retaining the ground water in basins for monitoring and subsequent discharge to the Toms River; and implementation of a river and ground water monitoring program. The estimated present worth cost for this remedial action is $164,500,000, which includes annual O&M of $12,539,000.

ATTENTION

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UNITED STATES
ENVIRONMENTAL PROTECTION
AGENCY

REGION II

RECORD OF DECISION
OPERABLE UNIT ONE

CIBA-GEIGY CHEMICAL CORPORATION SITE
TOMS RIVER, NJ

APRIL 24, 1989

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DECLARATION STATEMENT

RECORD OF DECISION

CIBA-GEIGY Chemical Corporation - Operable Unit I, Dover Township, Ocean County, New Jersey

STATEMENT OF PURPOSE

This decision document presents the selected remedial action for the CIBA-GEIGY Chemical Corporation site - Operable Unit I in Dover Township, New Jersey, developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300.

STATEMENT OF BASIS

I am basing my decision primarily on the following documents, which are contained in the administrative record for this site:

- Remedial Investigation for the CIBA-GEIGY site, prepared by NUS Corporation, January 22, 1988;
- Final Draft Feasibility Study for the CIBA-GEIGY site, prepared by NUS Corporation, April 29, 1988;
- Final Report - CIBA-GEIGY Technical Enforcement Support Document, Groundwater Modeling Report, CIBA-GEIGY, Toms River, New Jersey, prepared by Camp, Dresser & McKee, April 1989;
- Final Report - CIBA-GEIGY Plant, Groundwater Treatment Alternatives, Toms River, New Jersey, prepared by Camp, Dresser & McKee, April 1989;
- Proposed Remedial Action Plan, CIBA-GEIGY site, June 1988;
- The attached Decision Summary for the CIBA-GEIGY site,
- The attached Responsiveness Summary for the site, which incorporates public comments received; and
- Staff summaries and recommendations.

The State of New Jersey has concurred on the selected remedy.

DESCRIPTION OF THE SELECTED REMEDY

This operable unit was developed to protect public health and the environment by remediating the contaminated groundwater in the upper aquifer. The groundwater will be extracted until the federal and state cleanup standards are met to the maximum extent practicable. The operable unit is fully consistent with all planned future site activities. Future site activities include further evaluation of potential areas of contamination and development of measures to remediate these areas and further evaluation of the deeper aquifer and development of remedial measures for this aquifer, if required.

The major components of the selected remedy for the CIBA-GEIGY site - Operable Unit I are as follows:

- Sealing of contaminated residential wells in the Cardinal Drive area to prevent human exposure to contaminated groundwater.

- Installation of an extraction well system on and off site to stop migration of contaminated groundwater at the property line and capture the contaminated groundwater in the off-site areas.

- After extraction, treatment of the contaminated groundwater separately from the process wastewater in an upgraded existing CIBA-GEIGY wastewater treatment plant. The contaminated groundwater will be treated to the discharge levels as specified by the NJDEP for discharge to the Toms River.

- After treatment, the groundwater will be retained in basins to allow monitoring of residual contaminant levels prior to discharge through a pipeline to the Toms River.

- Monitoring of the Toms River to determine current water quality upstream, downstream, and adjacent to the site. Monitoring will continue during the implementation of the remedial action to evaluate the effects of the extraction system and river discharge over time.

DECLARATION

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300, I have determined the selected remedy is protective of human health and the environment, attains federal and state requirements that are applicable or relevant and appropriate for this remedial action and is cost-effective.

This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

April 24, 1989
Date

William J. Muszynski
William J. Muszynski, P.E.
Acting Regional Administrator

X

DECISION SUMMARY

CIBA-GEIGY CHEMICAL CORPORATION SITE - OPERABLE UNIT I

DOVER TOWNSHIP, NEW JERSEY

SITE NAME, LOCATION AND DESCRIPTION

The CIBA-GEIGY Chemical Corporation site is located on Route 37 in Toms River, Ocean County, New Jersey, about one mile west of the Garden State Parkway (refer to Figure 1). The site, presently owned by the CIBA-GEIGY Chemical Corporation, covers 1400 acres, 320 of which are developed; the remaining area is largely wooded. The manufacturing facility, which has been in operation since 1952, is composed of twenty-two buildings, a wastewater treatment plant which currently has an average operating capacity of 4.0 million gallons per day (MGD), and a lined reservoir for emergency storage of treated and untreated wastewater.

Topographically, the CIBA-GEIGY site is flat but drops off sharply toward the Toms River in the northeastern sector of the property. Winding River Park, an outdoor recreational area situated on the floodplain of the Toms River, adjoins the site to the east. A residential area borders the site to the southeast. The site is bounded on the west by an industrial park, and on the north and south by residential and commercial properties. Major residential developments, including two retirement communities, are located 1 mile south of the site. The business district of the town of Toms River lies 3 miles southeast of the site (refer to Figure 2).

Geologically, the CIBA-GEIGY site is directly underlain by the Kirkwood Formation and Cohansey Sand. In general, the Kirkwood Formation is composed of quartz-bearing very fine- to medium-grained sand and contains dark-colored micaceous, diatomaceous clay, known to be regionally extensive at the base of the formation. The Cohansey Sand is composed of light-colored, medium- to coarse-grained quartz sand with pebbles, and locally, clay beds. The thickness of the Kirkwood-Cohansey aquifer system in the vicinity of the CIBA-GEIGY site is approximately 205 feet. Perched water tables and semi-confined aquifer conditions occur locally within the Kirkwood-Cohansey aquifer system.

The drainage course of the Toms River traverses Ocean County along a 16-mile pathway from the northwest to the southeast. The main channel of the Toms River, along with associated tributaries of the river system, provides drainage to a basin encompassing 190 square miles. Surface waters from all tributaries in the northern drainage basin of the Toms River contribute to the hydraulic flow and water quality at the CIBA-GEIGY site.

Average stream discharge of the Toms River for the past 57 years at the CIBA-GEIGY site is 215 cubic feet per second (cf/s). Stream flows in the New Jersey Coastal Plain, including the surface water discharge in the Toms River are derived primarily from groundwater baseflow.

Water quality data for the past 20 years show that the waters of the Toms River are acidic, with a pH range of 3.4 to 7.8 and a median of 5.0. Surface waters are normally oxygen saturated; however, conditions of oxygen stress occurred during the summer months of 1966 and 1970. Biological oxygen demand (BOD) of the surface waters has remained within the expected concentration range of river water and presently ranges from 0.2 mg/l to 1.5 mg/l. Total nitrogen content of the river shows a trend toward decreasing concentrations over time. Total phosphorous has remained fairly stable, with a range of 0.01 to 0.20 mg/l. The total dissolved solids (TDS) level is approximately 35 mg/l.

From 1952 to 1966, operators of the site discharged treated effluent into the Toms River. Since 1966, the treated effluent has been sent to the Atlantic Ocean. Improved water quality in the Toms River, notably a decrease in nitrogen and BOD concentrations, may be related to these changes at the CIBA-GEIGY plant.

Municipal and Private Wells

The Kirkwood-Cohansey aquifer system in the area surrounding the CIBA-GEIGY site is tapped by municipal, industrial and private wells. The nearest public water supply well, owned by the Toms River Water Company and designated "TRWC 20," is located approximately 2200 feet from the site boundary on the east side of the Toms River. Privately-owned drinking water wells near the site are concentrated along the southwestern site boundary and in the southern portion of the Cardinal

Drive area, located between the eastern site boundary and the Toms River (refer to Figure 2). Several residents in the Cardinal Drive area also have irrigation wells. Additional residential drinking water wells are located along Coulter Street between well TRWC 20 and the Toms River (refer to Figure 2).

The U.S. Environmental Protection Agency (EPA) sampled both residential drinking water and irrigation wells several times beginning in the Spring of 1985. Elevated levels of mercury (which are not believed to be site-related) above EPA's Maximum Contaminant Level (MCL) of 0.002 mg/l were found in three private residential drinking water wells on Coulter Street. These residences have since been put on municipal water supplies. In addition, elevated levels of lead contamination above EPA's MCL of 0.05 mg/l were found in three private residential drinking water wells along the southwestern site boundary. One home has been placed on municipal water supplies. The contamination found in these wells is not believed to be site-related.

Elevated levels of volatile organic compounds (VOCs) and metals were also found in water from private irrigation wells in the Cardinal Drive area. Some of these contaminated irrigation wells have been sealed. Presently, all residences in the Cardinal Drive area which are within the CIBA-GEIGY plume use municipal water as their potable water source.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

According to CIBA-GEIGY, the manufacturing facility commenced operation in 1952 as the Toms River Chemical Corporation (TRC), jointly owned by Society of Chemical Industry, Basle (Ciba), J.R. Geigy, S.A., Basle (Geigy) and Chemical Works, the predecessor of Sandoz Limited (Sandoz). In 1970, the U.S. subsidiaries of Ciba and Geigy merged to become CIBA-GEIGY Corporation. From 1970 through 1981, TRC was jointly owned by Sandoz and CIBA-GEIGY. In 1981 Sandoz transferred all interest to CIBA-GEIGY.

From 1952 to 1988, a variety of synthetic organic pigments, organic dyestuffs and intermediates, and epoxy resins were manufactured at the site. Principal markets for these products were the paper and textile industries and the electronics industry. In 1988, CIBA-GEIGY phased out the dye manufacturing processes. According to CIBA-GEIGY, epoxy resin manufacturing processes are scheduled to end in late 1991. Dye standardization will continue indefinitely.

Currently, the company generates both liquid and solid wastes. The liquid wastes are treated on site in a wastewater treatment plant before discharging to the Atlantic Ocean. The solid wastes, consisting of residue from the manufacturing processes, are disposed off site, and sludges from the wastewater treatment plant are disposed in permitted double-lined, on-site landfills.

In 1987, the company applied to the New Jersey Department of Environmental Protection (NJDEP) for permits to convert the existing facility to a pharmaceutical manufacturing facility. On October 24, 1988, NJDEP denied these permits. On November 28, 1988, CIBA-GEIGY announced that it would not appeal the NJDEP permit denials and on December 6, the company announced that it would significantly reduce manufacturing operations at this location and close the current ocean outfall by December 31, 1991.

Wastewater Treatment Activities

Since 1952 until 1960, TRC operated an industrial wastewater treatment plant. According to CIBA-GEIGY, this plant consisted of an equalization basin, an oxidation lagoon, and a settling basin, with discharge to the Toms River. Of these units, only the equalization basin was lined. The liner, however, began to leak soon after the basin became operational. All liquid wastes were disposed through this treatment plant. Solid wastes were disposed in bulk on site.

In 1960, the existing treatment plant was closed except for the equalization basins, which were re-lined. A new treatment plant was built adjacent to the Toms River in the northeastern area of the site. A portion of the settling basin from the original wastewater treatment plant was converted to a solid waste disposal area for both drummed waste and other wastes such as iron sludge and biological sludge.

In 1966, the river discharge was closed and the treated effluent was sent to the Atlantic Ocean through a ten-mile pipeline.

The second wastewater treatment plant was closed in 1977 and a third, more modern treatment plant with lined basins was constructed. The sludge from the second treatment plant was sent to an on-site area known as the Filtercake Disposal Area, after which this area was closed and covered with soil.

On-Site Waste Disposal Activities

The company disposed of chemical wastes on site in several locations. These locations include:

- a 5.3-acre Drum Disposal Area (reported by CIBA-GEIGY to contain approximately 100,000 drums),
- a 3.9-acre Lime Sludge Disposal Area,
- a 12-acre Filtercake Disposal Area,
- five Backfilled Lagoons comprising approximately 8.5 acres, and
- a Calcium Sulfate Disposal Area.

Aerial photographs indicate that other areas designated as the Borrow Area, Casual Dumping Area and the suspected East Overflow Area may have also been used as waste disposal sites (refer to Figure 2).

The Drum Disposal Area was used from 1960 until 1977. Also during this time, the Filtercake Disposal Area was used for the disposal of sludge from the wastewater treatment plant. In addition, the Lime Sludge Disposal Area was used to dispose of inorganic wastes (including arsenic wastes) stabilized with calcium carbonate. Some of this waste was drummed, while some was disposed in bulk. The Drum Disposal Area and the Lime Sludge Disposal Area were closed in 1978. Investigations have shown that groundwater contamination is migrating from these inactive disposal sites in an easterly direction towards the Toms River. In addition to the closed disposal areas, an active landfill designed and permitted to accept wastewater treatment plant sludge is also located on site. After 1977, CIBA-GEIGY began disposing of waste in a double-lined permitted landfill and shipping waste off site for disposal.

Site Investigations

During the late 1970s and early 1980s, CIBA-GEIGY performed various closure activities and geohydrologic investigations at the site in response to NJDEP directives. These activities included closing the Drum Disposal Area and the Lime Sludge Disposal Area with 30-mil PVC caps in 1978, installing drainage swales and initiating geohydrologic studies to identify the sources of groundwater contamination and the direction and extent of contaminated plumes. Also, as early as 1979, there were reports of leakage of the double-lined Active Landfill and remedial measures were taken under the direction of the NJDEP Solid Waste Administration.

EPA completed an Identification and Preliminary Assessment report of the CIBA-GEIGY site under the Potential Hazardous Waste Site Program in 1980. The site was proposed for the National Priorities List in 1982 and was ranked at 166 nationally among 418 listed sites.

An Administrative Consent Order was entered into between the NJDEP and CIBA-GEIGY in 1981 to close Cell I of the Active Landfill, delineate conditions for the use of Cell II, sample and analyze leachate from Cells I and II, and monitor groundwater.

In 1981, CIBA-GEIGY began accepting waste for treatment and disposal from off site. In 1983, the Division of Water Resources (DWR) of NJDEP notified CIBA-GEIGY that further acceptance of hazardous/nonhazardous waste into the on-site wastewater treatment plant from off-site sources would be in violation of its New Jersey Pollution Discharge Elimination System Permit and would result in prosecution.

In 1984, the NJDEP discovered that CIBA-GEIGY was illegally disposing of drums containing liquids and hazardous waste in Cell II of its Active Landfill. This discovery led the New Jersey Division of Criminal Justice to conduct an investigation into the waste handling and disposal practices at the site. The criminal investigation resulted in indictments on two occasions, of several CIBA-GEIGY officials who were charged with the illegal disposal of chemical waste, filing false documents with the NJDEP, making false and misleading statements to the NJDEP, and illegal disposal of hazardous waste.

In 1985, CIBA-GEIGY notified EPA and NJDEP that the existing RCRA Equalization Basins may be leaking into the groundwater. Also in 1985, after discovering the disposal of hazardous wastes and liquids in the Active Landfill (permitted only for the disposal of nonhazardous solid wastes), NJDEP ordered CIBA-GEIGY to remove 14,000 drums from Cell II, pay a $1.65 million fine, and reorganize its Environmental Technology Department at the Toms River plant.

By 1986, CIBA-GEIGY had committed to close the leaking Equalization Basins and install purge wells to begin remediating the contaminated plume from these basins. A RCRA closure plan for the Equalization Basins was submitted to NJDEP in 1987.

Under the Comprehensive, Environmental, Response, Compensation and Liability Act of 1980 (CERCLA), EPA began the Remedial Investigation (RI) in January 1985 and released the RI report to the public in September 1986. The objectives of the RI were the following:

- to characterize the nature and extent of contamination associated with the site;
- identify site-related off-site contamination and its impact on the environment and on public health; and
- to determine the need for remedial measures to mitigate the impact of the site on public health and the environment.

After further review and analysis of the data, EPA released a revised RI in February 1988. This report presented a more conservative interpretation of the hydrogeology and extent of surficial soil contamination at the site than the earlier document. The principal revisions of the study included:

- a new hydrogeologic interpretation that the layers between the two aquifers are semi-confining, and therefore, a potential for contamination of the deeper aquifer zones exists,
- the identification of several additional areas of soil contamination requiring further evaluation, and

- discussions of additional potential source areas, such as the Borrow Area, the Suspected East Overflow Area and the Casual Dumping Area were expanded to provide more detail on the histories and locations of these areas.

After the RI, a Feasibility Study (FS) evaluating remedial alternatives was performed by EPA and was released to the public for comment in June 1988.

CERCLA Enforcement Activities

EPA issued general notice to CIBA-GEIGY in March 1984 to inform the company of its potentially responsible party (PRP) status and the Agency's intention of beginning the RI/FS process. In October 1984, because of the numerous violations and criminal actions related to the company's waste disposal activities, EPA denied CIBA-GEIGY the opportunity to perform the RI/FS under CERCLA. CIBA-GEIGY reimbursed EPA $1.085 million for RI/FS expenditures in June 1985.

In May 1988, EPA sent general notice to eighteen PRPs who contributed outside waste streams to the TRC/CIBA-GEIGY wastewater treatment facilities.

CIBA-GEIGY has formally requested to conduct additional studies needed to supplement the information obtained during the RI/FS process and to implement the remedial action for the first operable unit under EPA oversight. The company has publicly stated its willingness to conduct remedial activities at the site. In additio in a November 4, 1988 letter from CIBA-GEIGY to EPA, the company submitted a statement of qualifications in support of its request. CIBA-GEIGY confirmed its commitment in a March 8, 1989 letter to EPA.

COMMUNITY RELATIONS

This project has included extensive community relations activities and has received a significant amount of community input. Several groups, including the Ocean County Citizens for Clean Water (OCCCW) the Save Our Ocean Committee (SOOC), and the CIBA-GEIGY Oversight and Advisory Committee formed in response to concerns related to the CIBA-GEIGY Superfund site and the ocean discharge pipeline.

Beginning in December 1984 and continuing throughout the RI/FS process, EPA met with citizens' groups and held several public meetings to update the public on EPA's progress during the RI/FS.

In April 1986 and again in 1987, OCCCW requested a Technical Assistance Grant (TAG) from EPA. Since the regulations for issuing TAGs had not been developed, EPA suggested that the OCCCW request funding directly from CIBA-GEIGY. The company agreed to provide a $50,000 grant to the citizens which enabled them to hire technical consultants to review EPA's and CIBA-GEIGY's work. Additional monies were later provided to OCCCW by CIBA-GEIGY to allow the citizens' group to continue to obtain the services of technical consultants.

At the request of OCCCW, EPA developed a process to increase community involvement during the Feasibility Study. A series of technical meetings with both CIBA-GEIGY and OCCCW and its consultants was held during 1987 and 1988 to discuss EPA's development of the FS. As part of this process, an early draft of the FS was released to this group for input.

Proposed Remedy; Public Review

On June 23, 1988, EPA announced that the preferred alternative for groundwater remediation was to pump and treat the contaminated groundwater and discharge it through the existing CIBA-GEIGY pipeline to the Atlantic Ocean. EPA also stated that discharge to the Toms River, although producing a somewhat higher public health risk, was also acceptable. This announcement began a 60-day public comment period during which time a public meeting was held on August 2, 1988.

Due to the extensive public opposition to EPA's preferred remedy, EPA proposed to meet weekly with a group of Federal, State and local public officials and citizens groups to discuss potential alternatives to the ocean discharge. This group included mayors from the nearby towns and coastal communities, and representatives of the local water companies, health department, and several citizens' environmental groups, NJDEP and CIBA-GEIGY. The weekly meetings began July 21 and continued until October 27, 1988. EPA extended the formal comment period to November 4, 1988 during which time the Agency evaluated additional alternatives proposed by the group. Through this process, EPA was able to review a range of remedies in an attempt to develop a remedy which was acceptable to the Agency, NJDEP and much of the community.

SCOPE OF THE OPERABLE UNIT WITHIN SITE STRATEGY

As is the case with many Superfund sites, the contamination at the CIBA-GEIGY site is complex and extensive; it consists of a wide range of chemicals emanating from many source areas. The contaminants are present in leaking drums, waste sludges, soils and the groundwater. The complexity of such a situation necessitates addressing the contamination in discrete phases, referred to as operable units.

This Record of Decision for the first operable unit focuses on the remediation of groundwater contamination in the upper aquifer. Groundwater contamination was selected as the first operable unit of a multi-phase remedy because its nature and extent are best understood, the remedy can be implemented quickly, and it will reduce the most significant risk to public health while alternatives for source remediation are being evaluated.

Although EPA has conducted investigations of the waste disposal areas, further investigatory work is necessary. As a result, EPA has deferred remedy selection for the source areas until the nature and extent of contamination are more fully understood and treatability studies can be conducted. Remediation of the on-site source areas and the deeper aquifer (if needed) will be addressed in future operable units. In this way, the most significant public health concerns will be addressed by preventing further off-site migration of groundwater contamination. It is possible that remediating the contaminant source areas could shorten the time required to remediate the contaminated groundwater.

SUMMARY OF SITE CHARACTERISTICS

EPA accomplished the following major tasks during the RI:

- Historical geological, geophysical, hydrological, and chemical information was reviewed and evaluated.
- Eight boreholes were drilled to identify waste disposal areas. The wastes were sampled, analyzed and characterized. Waste volumes were calculated and the impacts of the waste deposits on groundwater, surface water and biological systems were assessed.

- Fifty-nine monitoring wells were installed and the subsurface data generated during the drilling were employed to determine and define the geology of the site area. Groundwater was sampled and analyzed in August and October 1985 and February, June and September 1986.
- Ground penetrating radar and terrain conductivity surveys were conducted throughout the site.
- One hundred eighty-nine shallow soil samples were collected and analyzed for Hazardous Substance List (HSL) parameters, indicator parameters, and dioxin to characterize contamination of on-site soils.
- Surface water, stream-bottom sediment, and insect populations were sampled at each of five locations along the Toms River adjacent to the site to determine the impact of the site on these systems.
- A "No Action" public health evaluation was performed to determine the potential impact of human exposure to contaminants.

During EPA's performance of the RI, CIBA-GEIGY and its consultants conducted parallel studies and additional investigations at the site. The work included the installation and sampling of additional monitoring wells, additional soil borings in some of the source areas, and sampling in the marsh area. Information from these investigations including data from more than 200 existing CIBA-GEIGY wells was used by EPA to supplement the data gathered for this RI.

Remedial Investigation Conclusions

The major conclusions of the RI are as follows:

- The two aquifers investigated at the site are separated by a thirty foot thick semi-confining layer of silt and clay located at an approximate depth of 100' below mean sea level.
- Groundwater in the upper aquifer flows towards and discharges into the Toms River. Site-related groundwater contamination appears to be restricted to the upper aquifer. Although most of the groundwater in the shallow aquifer ultimately discharges into the Toms River, locally some contamination has migrated a short distant beyond the Toms River. Figure

3 depicts the extent of volatile organic contamination in the Upper Sand Aquifer. Figures 4 and 5 depict the total concentration of volatile organic chemicals and inorganic chemicals, respectively, found in monitoring wells during the RI.

- The semi-confining layer of silt and clay appears to have prevented groundwater contamination from migrating into the lower aquifer. Unlike the shallow aquifer, groundwater in the lower aquifer does not discharge into the Toms River.
- The Backfilled Lagoons and the Filtercake Disposal Area contain large volumes of sludge; buried drums also appear to be present. These waste disposal areas are unlined, and the sludges in them contain significant concentrations of hazardous substances which are contributing to contamination of the shallow groundwater.
- The inactive Drum Disposal Area is releasing hazardous substances into the groundwater. The contaminants detected in the groundwater downgradient of the Drum Disposal Area closely match the chemicals known to have been disposed in this area.
- The surface soil sampling results reveal several areas where inorganic chemical contamination exists. The inorganic chemicals tend to be localized within the source areas. There is evidence that inorganic contaminants are migrating from the contaminated areas via surface water runoff.
- The public health evaluation for human exposure to contaminants emanating from the CIBA-GEIGY site indicates that, although at present no exposure exists, if no action is taken the population will eventually be exposed to a potentially significant risk. This is due to the fact that private drinking water wells are located south and southeast of the site. There is the potential that groundwater contamination could migrate to these wells if no remediation were undertaken.
- Potential routes of exposure include ingestion and dermal exposure of contaminated groundwater from existing irrigation wells, and ingestion of, dermal exposure to and inhalation of contaminants in a marshland adjacent to the Toms River.

- Approximately 95 chemicals were detected in the groundwater and soils at the site. Of these 95 chemicals, 17 were above MCLs. Some of the chemicals and contaminants identified at the site include: benzene, chlorobenzene, tetrachloroethene, trichloroethene, toluene, arsenic, cadmium, chromium, copper and mercury. (NUS Remedial Investigation, 1988.)

Appendix A lists the average and maximum concentrations of contaminants found in each of the media on and off site.

SUMMARY OF SITE RISKS

A public health evaluation (PHE) was performed for the CIBA-GEIGY site to determine the impact of the site on public health and the environment under various exposure scenarios and different contaminant pathways. This evaluation is presented in the "Quantitative Public Health Evaluation for the No Action Alternative at the CIBA-GEIGY Site" (NUS, April 1988.) The PHE identified 11 indicator chemicals in accordance with the EPA Superfund Public Health Evaluation Manual. The indicator chemicals selected for the CIBA-GEIGY Site are compounds that are in the groundwater, have a history of use and disposal at the site and were found in private wells off site (refer to Appendix A). These compounds are listed below.

Carcinogens	Noncarcinogens
Arsenic	Barium
Benzene	Cadmium
Chloroform	Chlorobenzene
1,2-Dichloroethane	Nickel
Tetrachloroethene	1,2,4-Trichlorobenzene
Trichloroethene	

The PHE involves four steps. The first step is to identify indicator chemicals to address the potential public health and environmental concerns associated with the site. The next step is to use the toxicity of each chemical to determine whether the contaminants present at the site may be associated with adverse health and/or environmental effects. The third step identifies likely exposure scenarios and defines the individuals who may be at risk via these exposure scenarios, as well as the most likely indicator compound concentrations associated with these scenarios. The PHE at CIBA-GEIGY used the maximum concentration of each indicator chemical detected in the groundwater or marshland sediment. The groundwater concentrations used were not directly in a source area.

Air concentrations for the residential exposure routes were calculated, while actual air concentrations found at the marshland were used for the recreational exposure scenarios. The final step in the process is the calculation of potential risks associated with exposure to indicator chemicals.

In the PHE, individual contaminants were separated into two categories of chemical toxicity depending on whether they cause carcinogenic or noncarcinogenic effects. In the case of chemicals exhibiting carcinogenic effects, exposures and associated risks are expressed in an exponential nomenclature, 1 x 10-4 (one in ten thousand), 1 x 10-7 (one in ten million), etc. EPA has used the range of 1 x 10-4 to 1 x 10-7 in evaluating risk. For chemicals exhibiting noncarcinogenic effects, exposures and associated risks are expressed as a ratio. This ratio, called a Hazard Index, is estimated by dividing the amount of a chemical that an individual might be exposed to by the amount of the chemical that will not cause any adverse health effects. A hazard index that is less than 1.0 indicates that no adverse health impacts would be expected. Summaries of the quantitations of carcinogenic risks and hazard indices are presented for residential and recreational exposure routes in Tables 1 and 2, respectively. The information in these tables is discussed in subsequent paragraphs.

Human Exposure Routes

The human exposure assessment for the CIBA-GEIGY site included the areas where the public could be exposed to contaminants migrating from the site. The data, which were obtained from the five media, namely groundwater, surface water, soil, sediments and air, indicated that human exposure to contaminated groundwater, marshland sediments and air and contaminated river water can occur.

The human exposure pathways were divided into two categories: exposure due to residential uses of contaminated groundwater and exposure due to recreational uses of a marshland adjacent to the river and the river itself, all of which are receiving contaminated groundwater. The residential exposure routes included ingestion, dermal absorption and inhalation of contaminants from residential well water. The recreational exposure routes included ingestion, dermal absorption and inhalation of contaminants from contaminated marshland sediments and the river through activities such as fishing and swimming in the river and walking in the marshland. These pathways are particularly relevant to children who play in this area. It should be noted, however, that the public health evaluation used extremely conservative assumptions related to lifetime exposures to chemicals from drinking, bathing, cooking, etc. with contaminated water for seventy years.

Wells in the vicinity of the CIBA-GEIGY site are currently used for residential purposes such as drinking, bathing and other domestic activities, as well as agricultural purposes such as watering lawns and gardens and filling swimming pools.

If an individual were to use a contaminated residential well for domestic purposes, exposure could result from ingestion of contaminated groundwater, dermal absorption of contaminants through showering and other domestic activities, and inhalation of contaminants volatilizing from sprayed water during activities such as showering.

The RI indicates that the marshland adjacent to the Toms River contains contaminated sediments. If an individual were to walk in the marshland area, exposure to contaminants could result from incidental ingestion of sediments, dermal absorption of contaminants from direct contact with sediments, and inhalation of contaminants volatilizing from the marshland area surface water. Exposure could also occur through fishing and swimming in the river.

The potential for significant exposure through dermal contact with, and incidental ingestion of on-site soils or wastes by trespassers is considered low due to the fact that much of the site is fenced and the wastes are buried and covered. Access to the site by unauthorized persons is restricted and monitored by CIBA-GEIGY's site security personnel. Off-site migration of contaminated soils does not appear to be occurring.

Summaries of the potential risks posed by each pathway evaluated in the PHE are given in Tables 1 and 2. Under certain conditions in which persons could be exposed to the contaminants through residential uses, the risk of contracting cancer would increase to 1 x 10-2. While this risk is significant, it is almost entirely from the residential exposure routes. Carcinogenic risk from human exposure from recreational uses alone is estimated at 8 in a million population.

Since the Hazard Index, a measure of noncarcinogenic risks, is greater than 1, chronic health effects due to exposure to the noncarcinogenic contaminants at the site can occur. As with the carcinogenic risk numbers, the Hazard Index is almost entirely based on the residential exposure scenarios. If all wells were to be capped, the Hazard Index would drop to below 1 and there would not be a chronic health hazard due to recreational exposure routes alone.

The Agency for Toxic Substances and Disease Registry (ATSDR) performed a Public Health Evaluation for the site. The Agency agrees that the human exposure pathways of concern are from oral, dermal and inhalation exposure to contaminated residential well water and contaminated surface water, sediment and air in the marshland area. Ingestion of contaminated plants from gardens or lawns irrigated with contaminated well water is also possible.

Environmental Media Sampling

As has been stated previously, contaminated groundwater is migrating from the site into the Toms River. A limited number of water and sediment samples was taken in the river, some of which indicated that low levels of trichloroethene were found in the surface water and chlorobenzene and benzene were found in the sediments.

Aquatic insect populations were surveyed along the Toms River. No aquatic insects were found at the confluence of the river and the CIBA-GEIGY cooling water discharge channel. This may be attributable to either thermal effects from the cooling water discharge or the trace levels of organics found in the surface water.

DESCRIPTION OF ALTERNATIVES

The major objectives of this first operable unit ROD are mitigation of the effects of groundwater contamination on public health and the environment and restoration of the Upper Sand Aquifer to drinking water standards. These objectives will be met by extracting both the contaminated groundwater on site and the plume of contaminated groundwater which has migrated off site and treating this contaminated groundwater for discharge to either surface waters or the aquifer.

Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, as amended by SARA, requires that remedial actions comply with all applicable or relevant and appropriate Federal and more stringent state requirements (ARARs) for the hazardous substances, pollutants, or contaminants that are present and attributable to a site.

Applicable requirements are defined as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Other information that does not meet the definition of ARAR but may be useful in developing a CERCLA remedy is to be considered (TBC). Criteria, advisories, or guidance developed by EPA, other Federal agencies, or States fall within the TBC category.

There are three categories of requirements with which Superfund actions may have to comply, namely, location-specific (refer to Appendix B), action-specific (refer to Appendix B and Tables 3 and 4) and chemical-specific (refer to Tables 5 and 6).

Location-specific requirements are restrictions of activities placed upon the concentrations of hazardous substances or the conduct of activities depending on the site or its immediate environs. Location specific requirements with regard to the CIBA-GEIGY site pertain to the discharge of treated groundwater to the Toms River or Atlantic Ocean. ARARs for the remediation of the contaminated groundwater include the Endangered Species Act of 1973; Executive Order 11990, Protection of Wetlands; Executive Order 11988, Protection of Floodplains; New Jersey State Coastal Management Program; and the National Historic Preservation Act.

Action-specific requirements set controls or restrictions on particular kinds of activities related to management of hazardous substances, pollutants or contaminants. Action-specific requirements specify particular performance levels, actions or technologies, as well as specific levels (or a methodology for setting specific levels) for discharged or residual chemicals. ARARs for discharge of treated groundwater to the Atlantic Ocean include the Federal Register dated November 5, 1987 Part IV 40 CFR Parts 414 and 416, Organic Chemicals and Plastics and Synthetic Fibers Category Effluent Limitations Guidelines, Pretreatment Standards, and New Source Performance Standards: Final Rule (refer to Appendix B). The specific standards based on the above regulation are presented in Table 3 as the discharge criteria for the Atlantic Ocean. Table 3A presents the concentration equivalents of these criteria.

ARARs for discharge of treated groundwater to the Toms River include the New Jersey State Surface Water Quality Standards (NJSWQS) (refer to Appendix B). New Jersey has proposed more stringent and protective NJSWQS which are anticipated to be promulgated in the near future. Due to their proposed status, these standards would be classified as TBCs. After consultation with New Jersey and in anticipation of promulgation, EPA has chosen to use these proposed standards in developing the Toms River discharge criteria (refer to Table 4). Table 4A presents the concentration equivalents of these criteria.

Chemical-specific requirements are usually health or risk-based concentration limits or ranges in various environmental media for specific hazardous substances, pollutants or contaminants. These requirements indicate an acceptable level of discharge (e.g., air emission or wastewater discharge taking into account water quality standards) for remedial activity. The New Jersey Safe Drinking Water Act (MCLs) are the required cleanup standards for the aquifer, a current source of drinking water, and for any treated groundwater which would be reinjected into the aquifer. Tables 5 and 6 present the chemical-specific ARARs for the site.

Components of Remedial Alternatives

The remedial alternatives for the first operable unit ROD are divided into three components.

Component 1 - Groundwater Extraction,
Component 2 - Treated Groundwater Discharge, and
Component 3 - Groundwater Treatment.

The remedial alternatives which were evaluated for these components are described below.

COMPONENT 1 - GROUNDWATER EXTRACTION ALTERNATIVES

The objective of Component 1 is to control the migration of contaminated groundwater at the CIBA-GEIGY site and in off-site areas and limit its migration into the Toms River. Five remedial alternatives were evaluated in the FS ranging from a No Further Action with Monitoring Alternative to the installation of extraction wells, reinjection wells and infiltration basins.

After the release of the FS and during the public comment period, EPA developed modifications of the original groundwater extraction/reinjection scenarios evaluated in the FS. These additional evaluations were performed in response to comments and questions from the public. This work effort is presented in the report entitled "Final Report - CIBA-GEIGY Technical Enforcement Support Document, Groundwater Modeling Report, CIBA-GEIGY, Toms River, New Jersey" (CDM, April 1989).

The extraction alternatives which were evaluated in this decision document are listed in Table 7. The extraction systems were designed to achieve three remedial objectives: 1) mitigate the groundwater contamination in the off-site residential areas, 2) limit the migration of groundwater contamination from the plant site and the property border, and 3) limit the downward vertical migration of contaminated groundwater and thus protect the semi-confined aquifer.

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

Implementation of this alternative would not eliminate or reduce carcinogenic or chronic health risks associated with exposure to contaminated groundwater. This alternative would require only regular sampling and analysis of selected groundwater wells, surface water and sediments to monitor the present contamination. Groundwater contamination would continue to move and disperse in an east-southeastward direction under residential areas and into the Toms River.

The continued leaching of contaminants from source areas could result in higher levels of contamination before natural attenuation occurs.

The health risk associated with the No Further Action Alternative is 1 x 10-2 due mainly to the ingestion of contaminated groundwater from potable wells.

ALTERNATIVE GE-2 GROUNDWATER EXTRACTION (GROUNDWATER MONITORING, SEALING OF RESIDENTIAL WELLS)

This alternative consists of sealing contaminated residential irrigation wells in the Cardinal Drive Area to prevent potential human exposure to contaminated groundwater through the use of these wells. At present, no drinking water wells in this area have been found to be contaminated from the site. There are no drinking water wells in the area of the plume and no contamination has been found in drinking water wells which exist south of the plume. However, there are contaminated irrigation wells located within the CIBA-GEIGY groundwater contamination plume.

It is estimated that twenty-eight extraction wells would be installed and operated on the CIBA-GEIGY property and along the Toms River (refer to Figure 6). Computer modeling efforts have indicated that about 2.7 to 4.0 million gallons per day

(MGD) of groundwater would need to be extracted to mitigate groundwater contamination under this scenario. For estimating purposes in this ROD, it was assumed that approximately 3.3 MGD of contaminated groundwater would be extracted. The extraction wells would be placed so that they would most effectively and efficiently capture the plume and produce or maintain an upward groundwater flow gradient.

Groundwater quality would be monitored quarterly. The monitoring wells would aid in verifying the effectiveness of the groundwater extraction well program.

One potential constraint in implementing this alternative is that extraction wells may create a relatively stagnant zone of groundwater movement in the Cardinal Drive Area. As a result, the cleanup time within this stagnant area is estimated to be longer than for cases which include injection of clean water or reinjection and/or infiltration of treated groundwater. To address this potential concern, the remedial design would be developed so as to minimize or eliminate the stagnation effect by increasing the number of extraction wells. Additional extraction wells would be added to assure an upward groundwater flow gradient in this area and other contaminated areas of the site. Creating an upward flow gradient would cause contaminants to be drawn upward and prevent them from migrating deeper into the aquifer system.

ALTERNATIVE GE-3 GROUNDWATER EXTRACTION WITH INJECTION OF CLEAN WATER (GROUNDWATER MONITORING, SEALING OF RESIDENTIAL WELLS)

This alternative is similar to Alternative GE-2 above with the addition of three injection wells installed along the southeastern property border of the site. Clean water (from either a deeper aquifer, a potable source or the Toms River) would be injected into the Upper Sand Aquifer to promote a flushing action in the Cardinal Drive area (refer to Figure 7). These injection wells would accelerate the cleanup of the contaminated groundwater and reduce the size of the stagnation zone which occurs in Alternative GE-2. However, there is concern that injection could cause some downward vertical migration of contaminated groundwater. It is estimated that approximately 3.9 MGD would be extracted, treated and discharged with approximatley 0.38 MGD of clean water injected through the three injection wells.

Additional constraints in implementing this alternative include concerns related to the high maintenance required for injection wells and the potential for clogging of both the wells and the aquifer from the precipitation of metals such as iron in the aquifer.

COMPONENT 2 - GROUNDWATER DISCHARGE ALTERNATIVES

After extraction, the groundwater must be treated and discharged. The type and level of treatment of the contaminated groundwater is dependent on the discharge location selected. Table 8 lists the alternatives for groundwater discharge. These alternatives are described in subsequent paragraphs.

Treated Groundwater Holding Basins

During the public comment period, representatives of several citizens' environmental groups requested EPA to evaluate the use of holding basins for the treated groundwater prior to discharge. The citizens' representatives stated that holding basins could afford certain safeguards to public health and the environment should unexpected problems arise with the groundwater treatment plant. As a result of this request, EPA evaluated the function and benefits of these basins.

The holding basins would serve five beneficial functions:

1) provide retention capacity should a major problem develop with the groundwater treatment plant;

2) provide equalization of the treated groundwater;

3) provide additional filtration of the treated groundwater;

4) provide a certain amount of retention time during which analyses could be performed to determine if the treated groundwater were within discharge permit limitations; and

5) provide public confidence of the groundwater treatment and discharge systems.

The construction and location of the holding basins would be the same for all groundwater discharge alternatives with the exception of Alternative GD-4, which would consist of treatment at the Ocean County Utilities Authority and would therefore not require retention basins. The basins would be located in the northeast quadrant of the site and would consist of aboveground tanks. It is envisioned that two tanks, each with a capacity of 4 million gallons, may be required. A thick layer of sand and gravel would cover the bottom of the basins and would serve to remove additional fines from the treated effluent. After the treated groundwater filters through the sand and gravel, it would be collected in an underdrain system and then piped to the discharge point. The sand and gravel layer would be periodically reconditioned in order to maintain a satisfactory rate of infiltration.

Since these basins would be constructed above ground with bottoms, they would not result in groundwater mounding that could adversely effect the direction of groundwater flow or groundwater contaminant migration. Should it be determined that treated groundwater contained in the basins did not meet discharge permit requirements, the basin contents would be piped back to the treatment plant to be retreated.

An alternative to constructing new holding basins would be to use the existing 75 million gallon emergency reservoir. This would result in an estimated savings of up to $4 million.

For the ocean discharge option, treated groundwater from the holding basins would be discharged directly into the existing CIBA-GEIGY ocean outfall pipeline.

For the Upper Sand Aquifer recharge option, treated groundwater would be directed from the holding basins to infiltration basins and/or the reinjection well network.

Two options are possible for river discharge: direct discharge and indirect discharge. For the direct river discharge option, treated groundwater would be fed directly from the holding basins to the Toms River via a pipe. The indirect river discharge option would employ a network of gravel filled channels located along the banks of the Toms River which would allow treated groundwater from the holding basins to flow into the Toms River. Treated groundwater from the holding basins would be distributed throughout this seepage network by a system of pipes.

ALTERNATIVE GD-1 OCEAN DISCHARGE THROUGH THE EXISTING CIBA-GEIGY PIPELINE

CIBA-GEIGY is currently discharging treated process wastewater through its outfall to the Atlantic Ocean. Alternative GD-1 would continue this process by discharging the treated groundwater into the ocean.

The company has recently announced that it will end using its pipeline for ocean discharge of treated process wastewater by December 31, 1991. By this date, CIBA-GEIGY's process flows, laboratory wastewater and other miscellaneous flows would decrease to approximately 600,000 gallons per day. This volume would then either be sent to the OCUA for treatment or treated and discharged to the Toms River.

Alternatives for Discharge to the Toms River

As previously discussed, the treated groundwater from the holding tanks can be discharged to the Toms River either directly by a pipe or by a network of channels.

ALTERNATIVE GD-2A DISCHARGE TO THE TOMS RIVER BY PIPE

In this alternative, the treated groundwater would be discharged to the Toms River adjacent to the site by a pipeline from the holding tanks.

ALTERNATIVE GD-2B DISCHARGE TO THE TOMS RIVER BY SEEPAGE NETWORK

In this alternative, the treated effluent from the holding tanks would be piped to a seepage network which consists of perforated pipes placed in gravel-filled, concrete channels which discharge to the Toms River.

Alternatives for Discharge to the Upper Sand Aquifer

In these alternatives, some or all of the treated groundwater would be recharged into the Upper Sand Aquifer. This could be accomplished using reinjection wells and/or infiltration basins.

ALTERNATIVE GD-3A DISCHARGE TO UPPER SAND AQUIFER 30% REINJECTION OF TREATED GROUNDWATER

As previously mentioned, additional groundwater recharge scenarios were modeled and evaluated after the release of the FS in response to comments from the public. One of the primary objectives of these scenarios was to determine the maximum volume of treated groundwater which could be recharged on-site without causing negative impacts to the vertical or horizontal groundwater flow regime. A primary consideration of the groundwater remediation scenarios was maintaining the existing groundwater flow field below the CIBA-GEIGY site. The maximum amount of groundwater which could be returned to the aquifer was determined with the stipulations that there would be no reversal in the vertical groundwater gradient which would result in pushing contaminants further down into the aquifer and no change in the horizontal gradient which would affect the plume of the off-site contamination located north/northwest of the site. There is currently groundwater contamination in a residential area adjacent to the northern property border which groundwater modeling has shown could spread to uncontaminated areas as a result of the reinjection of large volumes of water on the site. For this reason, in most cases, the groundwater was recharged upgradient of the sources in the western portion of the site. Specifically, the present groundwater flow through the Semi-Confining Unit (separating the Upper Sand Aquifer from the Lower Sand Aquifer) and the horizontal flow patterns in the adjacent residential areas were used as a baseline with which to compare changes in the flow regime produced by each extraction/recharge scenario.

The following scenarios were evaluated as part of this analysis:

- 10%, 30%, 50% and 90% recharge of treated groundwater using infiltration basins;
- 90% recharge of treated groundwater using reinjection wells;

- 90% recharge of treated groundwater with 70% reinjected into a deep aquifer;
- 90% recharge of treated groundwater with 70% infiltrated in the northeast portion of the site along the Toms River;

In each case, 10% of the treated groundwater was also returned through reinjection wells in the Cardinal Drive Area.

These evaluations indicated that approximately 10 to 15% of the extracted groundwater could be returned to the Upper Sand Aquifer upgradient of the source areas without significantly impacting the horizontal or vertical flow regime.

Using these analyses, it was concluded that as much as 30% of the extracted groundwater could be reinjected or infiltrated into the Upper Sand Aquifer (10 to 15% in the Cardinal Drive Area and 10 to 15% upgradient of the source areas) without negatively impacting the present groundwater flow conditions. The remaining treated groundwater would need to be discharged to a surface water or the municipal treatment plant.

ALTERNATIVE GD-3B DISCHARGE TO UPPER SAND AQUIFER 100% REINJECTION OF TREATED GROUNDWATER

In this alternative, the extraction wells would be placed as in Alternative GE-3, however, all treated groundwater would be recharged into the Upper Sand Aquifer through three Cardinal Drive reinjection wells and 15 reinjection wells installed along the southwestern and northwestern property borders of the site (refer to Figure 8). The effluent would be treated to drinking water standards before reinjection. Approximately 4.0 MGD of contaminated groundwater would be extracted, treated and reinjected into the Upper Sand Aquifer.

A constraint associated with this alternative is the altering of the present groundwater flow direction and, consequently, potentially spreading contamination in adjacent areas. The groundwater contamination in the residential area to the north of the site would be expected to spread to uncontaminated areas.

There is also the consideration that the reinjected groundwater could force contaminants vertically downward through the area's semi-confining layer into the deeper aquifer. The maintenance problems related to reinjection wells (discussed in Alternative GD-3A) would again be a concern in this alternative, and to a greater degree, as there are many more reinjection wells and there is a much greater volume of water being reinjected.

Concerns associated with this alternative include the high maintenance required for the reinjection wells and the potential of clogging of both the wells and the aquifer from the precipitation of iron in the aquifer.

Finally, the increase in horizontal groundwater flow from the reinjection of 4.0 MGD would make it more difficult to capture all of the contamination before it reaches the river. As a result, an increase in extraction well pumpage rates would be required to capture the contaminated groundwater, although it is estimated that groundwater cleanup times would be shorter than those from previous alternatives.

Deep Aquifer Reinjection

Reinjection into the deeper aquifer was also simulated and evaluated to determine the impact of deep aquifer reinjection on the regional groundwater flow regime and the feasibility of reinjecting treated groundwater into the deeper semi-confined aquifer.

Evaluation of the deep aquifer reinjection scenarios revealed the following: 1) reinjection into the Lower Sand Aquifer may induce upward groundwater flow through the Semi-Confining Unit to the Upper Sand Aquifer; and 2) treated groundwater reinjected into the Lower Sand Aquifer could potentially migrate into the public drinking water supply wells.

Deep aquifer reinjection was not considered further because of the maintenance problems related to reinjection wells which have been previously discussed, the potential impact of the treated contaminated groundwater on residential and public supply wells, and the availability of other alternatives.

ALTERNATIVE GD-3C DISCHARGE TO UPPER SAND AQUIFER 100% RECHARGE OF TREATED GROUNDWATER USING REINJECTION WELLS AND INFILTRATION BASINS

In addition to the supplemental groundwater extraction/reinjection scenarios which were performed during the public comment period, the differences between recharging groundwater through reinjection wells versus infiltration basins were evaluated further. Two significant differences between these methods were identified. First, reinjection wells induce a greater horizontal flow component in the Upper Sand Aquifer than do infiltration basins. This is due to the fact that the reinjection wells are distributed over a larger area in the western portion of the site. Thus, the water tends to spread out more in a horizontal direction. However, infiltration basins induce a greater vertical flow component across the Semi-Confining Unit than do the reinjection wells. This is due to the concentrated application of treated groundwater in a smaller area. The horizontal component of flow decreases, but because the water is concentrated in a smaller area, a greater vertical flow component is produced.

Additional differences between reinjection wells and infiltration basins are that reinjection wells are more expensive to operate and maintain and are more susceptible to fouling than are infiltration basins.

Alternative GD-3C is similar to Alternative GD-3B with the exception that two infiltration basins would be designed to infiltrate 3.7 MGD of treated groundwater in the western portion of the site instead of the majority of reinjection wells to recharge the Upper Sand Aquifer (refer to Figure 9). The three Cardinal Drive wells would still be used to reinject 0.4 MGD to flush the residential area. The groundwater flow patterns in this alternative are similar to those in Alternative GD-3B, that is, significant changes in horizontal groundwater flow direction are predicted to occur in nearby off-site contaminated areas. Additionally, the downward vertical migration of contaminants is still a concern with this scenario. However, the maintenance concerns related to well clogging would be less than in Alternative GD-3B. Aquifer clogging problems from the introduction of water into the aquifer would still exist. Maintenance costs related to infiltration basins are substantially less than those related to injection wells.

Alternative Placement of Infiltration Basins

Placing the infiltration basins in other locations on site (other than upgradient) was also evaluated during the public comment period. However, in each case, either horizontal flow was impacted in off-site areas, or downward vertical gradients were created through the Semi-Confining Unit either beneath contaminant source areas or where upward gradients presently exist. Since one of the requirements of the groundwater modeling effort was to maintain the present groundwater flow conditions in the area, it was determined that the placement of basins in the western portion of the site was necessary.

ALTERNATIVE GD-4 DISCHARGE TO OCEAN COUNTY UTILITIES AUTHORITY

For this alternative, after extraction, the groundwater would be discharged to the OCUA treatment plant. The groundwater would be pretreated, if necessary, in a CIBA-GEIGY treatment system before being transported via pipeline to the OCUA plant. Either the existing municipal sewerage system would be used or, if the existing system is at hydraulic capacity, a new pipeline would have to be constructed to transport the groundwater. At the OCUA plant, the groundwater would receive secondary treatment prior to discharge to the Atlantic Ocean via the OCUA pipeline.

COMPONENT 3 - GROUNDWATER TREATMENT ALTERNATIVES

The four treatment options evaluated in the FS for the extracted groundwater are the following: the existing CIBA-GEIGY wastewater treatment plant, a newly constructed on-site treatment plant, the Ocean County Utilities Authority treatment facility and an in-situ bioreclamation system.

During the extended public comment period, as part of the supplemental FS effort, the groundwater treatment alternatives were evaluated in more detail. This information is described in a document entitled, "Final Report - CIBA-GEIGY Plant, Groundwater Treatment Alternatives, Toms River, New Jersey" (CDM, April 1989) and is discussed in the following evaluation of treatment alternatives.

The alternatives involving groundwater treatment are listed in Table 9. The information in this table indicates that the groundwater alternatives include treatment in the existing CIBA-GEIGY treatment facility, in a new on-site facility, at the OCUA plant and in situ.

The objective of Component 3 is to treat the extracted groundwater to the level required in a New Jersey Pollution Discharge Elimination System (NJPDES) permit for the appropriate discharge point, namely the ocean, river or aquifer. These options can be conducted through either an on-site treatment facility or in situ or off site through the OCUA facility. The criteria for on-site treatment for discharge to the ocean and river are listed in Tables 3 and 4, respectively. The criteria for on-site treatment for discharge to the aquifer are presented in Tables 5 and 6. For all treatment alternatives, it was assumed that the groundwater would be treated at a rate of 4 MGD.

Existing Wastewater Treatment Plant Operation

CIBA-GEIGY's wastewater treatment plant currently maintains tertiary treatment using biological activated sludge with powdered activated carbon. The plant treats approximately 1.1 MGD of process wastewater, 0.5 MGD of contaminated groundwater and 0.5 MGD of other miscellaneous flows such as laboratory wastes, sanitary wastes, landfill leachate and stormwater runoff.

A schematic of the existing treatment facilities is presented in Figure 10. Influent wastewater initially undergoes pH adjustment in two primary tanks before entering two equalization tanks. Chemical precipitation of metals and suspended solids is then accomplished by adding ferric chloride and lime prior to clarification. Subsequently, the flow enters the aeration basin where powdered activated carbon (PACT®) is added for biodegradation of organic contaminants. Finally, the wastewater undergoes secondary clarification and is discharged to the Atlantic Ocean through a ten-mile pipeline. Sludges from these processes are eventually disposed in the on-site Active Landfill.

CIBA-GEIGY Wastewater Treatment Plant Alternatives

As shown in Table 9, six alternatives were evaluated using CIBA-GEIGY's wastewater treatment plant. Two possible influents to the treatment plant were considered: groundwater combined with process wastewater, and groundwater only. For each case, the treatment plant was evaluated for treating the wastewater to meet ocean discharge criteria. It is noted that an alternative for treatment of contaminated groundwater combined with process wastewater to meet river or aquifer discharge criteria was not evaluated. The discharge of process wastewater is permitted by the State of New Jersey, Division of Water Resources, and is not regulated by CERCLA.

The treatment plant was also evaluated assuming the treatment of groundwater only with discharge to either the Toms River or the Upper Sand Aquifer (recharge). The choice of the receiving water for the plant effluent determines what modifications are required for the existing plant to meet the permit requirements of such a discharge.

ALTERNATIVE GT-1A CIBA-GEIGY WASTEWATER TREATMENT PLANT COMBINED TREATMENT OF PROCESS WASTE AND GROUNDWATER WITH DISCHARGE TO THE ATLANTIC OCEAN

The existing treatment plant was preliminarily evaluated in the FS. It is believed that the current treatment plant, with some modifications, could treat the combined waste streams. However, pilot studies would be required to confirm this. It should be noted that the volume and composition of process wastewater has been decreasing and changing during the past few years and will continue to exhibit this trend through 1991 as CIBA-GEIGY phases out additional processes.

ALTERNATIVE GT-1B CIBA-GEIGY WASTEWATER TREATMENT PLANT SEPARATE TREATMENT OF PROCESS WASTEWATER AND GROUNDWATER WITH DISCHARGE TO THE ATLANTIC OCEAN

The feasibility of utilizing the CIBA-GEIGY treatment plant and hydraulically separating the process wastewater and contaminated groundwater is dependent upon utilizing some existing duplicate process units and constructing some new process units in addition to new pumping and piping facilities. The determination that the existing treatment facility could handle the two separate waste streams was based on the assumption that the need for redundant or standby units could be waived. An existing 75 million gallon emergency reservoir is available to provide temporary storage for process wastewater. In addition, the groundwater extraction system could be shut down for periods of time while system repairs are performed.

In order to divide the existing plant facilities for separate treatment of the process wastewater and contaminated groundwater, the following process modifications and additions would be required:

1) an existing equalization tank would be converted to a volatile organics stripping reactor;

2) an aeration basin would be modified to allow for the addition of PACT®. A second aeration basin may also be needed;

3) a secondary neutralization reactor would be refurbished for chemical addition and pH control;

4) a flocculation tank would be added for metals removal;

5) a new sludge thickening tank would be installed; and

6) a carbon regeneration system consisting of a 30,000-gallon holding tank and two wet air oxidation reactors would be built.

Figure 11 shows this process train using the available units with the proposed modifications and additions required to treat the groundwater flow.

ALTERNATIVE GT-1C CIBA-GEIGY WASTEWATER TREATMENT PLANT TREATMENT OF CONTAMINATED GROUNDWATER ONLY WITH DISCHARGE TO THE ATLANTIC OCEAN

To treat the contaminated groundwater in the CIBA-GEIGY treatment plant to meet ocean discharge criteria, the following modifications in existing units and new unit processes would be required:

1) both equalization tanks would be refurbished for volatile organic carbon removal;

2) new mixers would be installed in the secondary neutralization reactors;

3) an aeration basin would be upgraded;

4) a new flocculation tank may be needed;

5) a new carbon regeneration system would be added.

Figure 13 shows the flow diagram of a modified plant for treating groundwater only with discharge to the Atlantic Ocean.

It is envisioned that under this alternative, process wastewater would be handled in a separate treatment facility either on or off site. The handling of the process waste is not included as part of this Record of Decision.

ALTERNATIVE GT-1D CIBA-GEIGY WASTEWATER TREATMENT PLANT SEPARATE TREATMENT OF PROCESS WASTEWATER AND CONTAMINATED GROUNDWATER WITH DISCHARGE TO THE TOMS RIVER OR UPPER SAND AQUIFER

The discharge criteria for the Toms River or the Upper Sand Aquifer require additional removal of volatile organics, metals, and total dissolved solids. Significant plant modifications are deemed necessary in order to meet these discharge criteria. Also, additional metals precipitation, carbon adsorption, and solids removal with a reverse osmosis unit would be required. Of note, is the need for the reverse osmosis unit to reduce the total dissolved solids from an estimated concentration of 2,000 mg/l to 50 mg/l.

The modifications described for Alternative GT-1C represent the treatment operations which would treat the groundwater to ocean discharge criteria. However, a greater degree of treatment could be achieved by optimizing the chemical precipitation of metals and operating two aeration basins in series.

The following new treatment processes would be applied to the effluent from the secondary clarifiers:

1) a filtration unit to remove suspended solids, organics and metals;

2) a reverse osmosis unit to remove dissolved solids (the side stream generated from this process would be treated on site to reduce the volume and then disposed off site); and

3) 12 granular activated carbon units to remove residual organic compounds;

Figure 13 shows the process modifications needed for treatment of the groundwater through separation of the two waste streams in the existing treatment plant.

ALTERNATIVE GT-1E CIBA-GEIGY WASTEWATER TREATMENT PLANT TREATMENT OF CONTAMINATED GROUNDWATER ONLY WITH DISCHARGE TO THE TOMS RIVER OR UPPER SAND AQUIFER

The same treatment units described in Alternative GT-1D would be required for this alternative. Figure 14 shows the process modifications needed to treat groundwater only with use of the entire treatment plant.

ALTERNATIVE GT-1F CIBA-GEIGY WASTEWATER TREATMENT PLANT TREATMENT TO NONDETECTABLE LEVELS

During the extended public comment period, citizens' environmental groups requested that treatment of contaminated groundwater to undetectable levels also be evaluated to determine the treatment requirements for attaining nondetectable levels. In response to this request, process trains capable of treating the contaminated groundwater to "nondetectable" levels were also developed in the treatment report previously referenced (CDM, April 1989). Nondetection was defined as 0.5 micrograms per liter (ug/l) for volatile organic compounds. The treatment requirements would be similar to those of Alternatives GT-1D and GT-1E with the exception that a two-stage PACT® process would be added to maximize removal of organics. The filtration and reverse osmosis processes would remain the same. It is estimated that the number of carbon adsorbers would be increased from 12 to 24 units. Figures 15 and 16 depict the treatment modifications necessary to achieve these discharge limits.

However, as will be discussed in subsequent sections of this document, since there are other treatment alternatives that would produce a high quality treated groundwater which would be fully protective of public health and the environment, EPA does not believe that the additional treatment costs to attain nondetectable levels are justifiable. For this reason, treatment to nondetectable levels will not be included as part of the comparative analysis of alternatives according to the nine remedial criteria.

Alternatives for a Newly Constructed On-Site Wastewater Treatment Plant

As shown in Table 9, four alternatives involving the construction of a new on-site wastewater treatment plant were evaluated. Included were a physical/chemical treatment plant which was conceptually designed in the FS and a separate biological treatment plant which was designed in the treatment report previously referenced (CDM, April 1989).

ALTERNATIVE GT-2A NEW PHYSICAL/CHEMICAL TREATMENT PLANT WITH DISCHARGE TO THE ATLANTIC OCEAN

The major design elements for the physical/chemical treatment plant were metals and organics separation with flocculation/sedimentation; volatile organics removal through air stripping, and additional organics and inorganics removal by carbon adsorption and filtration. In addition, it is envisioned that a fixed-film, biological reactor would also be required to attain the ocean discharge standards.

The process train required for such a plant would include the following:

1) a rapid mix tank for coagulation;
2) a flocculation tank to precipitate metals;
3) an air stripper to remove volatile organics;
4) a fixed-film biological reactor;
5) a clarifier to settle suspended solids;
6) a gravity filtration unit to remove particulates; and
7) a granular activated carbon system for additional carbon adsorption.

Figure 17 illustrates the treatment train which would be required for this alternative.

ALTERNATIVE GT-2B NEW BIOLOGICAL TREATMENT PLANT WITH DISCHARGE TO THE ATLANTIC OCEAN

The process train for this alternative consists of five stages of contaminant removal:

1) iron, aluminum and particulate removal by coagulation, sedimentation and filtration;

2) volatile organics removal through air stripping;

3) BOD and semi-volatile organics removal through an activated sludge/PACT® system;

4) suspended solids removal through sedimentation and filtration; and

5) nonbiodegradable semi-volatile organics removal through a PACT® system.

A schematic of the process train for this alternative is presented in Figure 18.

ALTERNATIVE GT-2C NEW BIOLOGICAL TREATMENT PLANT WITH DISCHARGE TO THE TOMS RIVER OR UPPER SAND AQUIFER

The treatment processes required to discharge the treated groundwater to the Toms River or Upper Sand Aquifer are basically the same. The plant would be similar to that discussed in Alternative GT-3B with the following modifications and additions:

1) a carbon adsorption unit would be required for final adsorption of organics;

2) a reverse osmosis unit would be added after the filtration step to remove total dissolved solids which must be reduced to less than 500 mg/l for discharge to the aquifer and to 50 mg/l for discharge to the Toms River;

3) the reject stream from the reverse osmosis unit would be treated by evaporation and then disposed off site.

Figure 19 shows the treatment processes for this alternative.

ALTERNATIVE GT-2D NEW BIOLOGICAL TREATMENT PLANT WITH TREATMENT TO NONDETECTABLE LEVELS

The treatment requirements for this alternative are the same as those described in Alternative GT-3C. However, for the additional removal of organic contaminants which would be required to reach nondetectable levels, the sizes and/or numbers of air strippers, vapor-phase carbon adsorption units and liquid-phase carbon adsorption units would be expanded. Figure 20 illustrates the treatment units which would be required for this alternative. For the reason stated under the discussion of Alternative GT-1F, treatment to nondetectable levels will not be included as part of the comparative analysis of alternatives according to the nine remedial criteria.

ALTERNATIVE GT-3 OCEAN COUNTY UTILITIES AUTHORITY WASTEWATER TREATMENT PLANT

The Ocean County Utilities Authority (OCUA) operates three wastewater treatment plants of which the central plant serves the areas surrounding the CIBA-GEIGY site. The central plant achieves secondary treatment before discharging into the Atlantic Ocean.

An OCUA facility would be a potential alternative for the treatment of contaminated groundwater at the CIBA-GEIGY site. However, there were several constraints and disadvantages associated with this alternative:

1. The central plant does not have the hydraulic capacity to handle the additional 4.0 MGD of contaminated groundwater.

2. The secondary treatment of the municipal plant does not meet the level of treatment currently attained by CIBA-GEIGY. Under this alternative, the contaminated groundwater would undergo a lower degree of treatment and be discharged into the Atlantic Ocean.

3. The northern and southern plants are located at excessive distances from the CIBA-GEIGY site. Major modifications, including constructing a pipeline from the CIBA-GEIGY plant to a tie-in point for the northern and southern OCUA plants, would be needed.

In consideration of the above, the OCUA was not considered further as a treatment and discharge alternative for the contaminated groundwater.

ALTERNATIVE GT-4 IN SITU BIORECLAMATION SYSTEM

The in-situ bioreclamation alternative requires the use of microorganisms in the ground to degrade the contaminants in the groundwater. Figure 21 is a generalized flow sheet of the system. Extraction wells located downgradient or within the plume would collect the contaminated groundwater. The groundwater would then be pumped to surface-mounted bioreactors in which microorganisms are acclimated to the specific chemicals in the groundwater and to the desired subsurface environment. The microbe-rich and nutrient-rich effluent from the bioreactors would be reinjected into the subsurface via reinjection wells. The biodegradation process would then continue in the subsurface system.

The implementation of an in-situ biodegradation aquifer restoration system is complicated at the CIBA-GEIGY site by the large area of the contaminant plumes, the numerous contaminant sources, the diversity of organic and inorganic contaminants and the depth of the contamination within the aquifer. Comprehensive tests are needed to indicate whether the groundwater can be acclimated to biological degradation, what species of microorganisms are best suited, and site-specific kinetic considerations. There is concern regarding the level of treatment achievable and the possibility of partially treated or untreated contaminated groundwater continuing to migrate from the site.

Operation and maintenance requirements of a bioreclamation system are similar to those of a groundwater extraction and treatment system. In addition, monitoring of physical and chemical parameters such as dissolved oxygen, pH, nutrients and organic constituents would be necessary.

Due to the uncertainties mentioned in the previous paragraphs, in-situ bioreclamation was not considered further for the treatment of the contaminated groundwater.

SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA's selection of a remedial alternative must be in accordance with the requirements of CERCLA, 42 U.S.C. Secs. 9601 et seq., and the requirements of its governing regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300.

In this section, the relative performance of the alternatives are summarized by highlighting the key differences between the alternatives in terms of nine criteria.

The nine remedial criteria summarize the requirements of CERCLA 121(b) and are as follows:

1. overall protection of human health and the environment,
2. compliance with applicable or relevant and appropriate requirements (ARARS),
3. long-term effectiveness and permanence,
4. reduction of toxicity, mobility or volume,
5. short-term effectiveness,
6. implementability,
7. cost,
8. state acceptance and
9. community acceptance.

1. OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion addresses whether or not a remedy provides adequate protection of human health and the environment and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

This alternative would not result in reducing the public health and environmental risk associated with exposure to contaminated groundwater. Specifically, contaminated groundwater would continue to migrate off-site, potentially into deeper aquifers, and into both public and private drinking water supplies. Additionally, contaminated groundwater would continue to migrate into the Toms River, potentially adversely impacting aquatic populations.

The long-term public health and environmental impacts of selecting this alternative would be significant, if no further action were taken and source control were not achieved.

COMPONENT 1:

ALTERNATIVE GE-2 GROUNDWATER EXTRACTION
ALTERNATIVE GE-3 GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WATER

The objective of both of these extraction scenarios is to stop off-site migration of contaminated groundwater at the property line, remediate the contaminated groundwater in the off-site areas, and create upward vertical gradients beneath the contaminant source areas. The risks to public health and the environment from current- and future-use exposure scenarios would be mitigated, resulting in protection of public health and the environment.

Alternative GE-2, extraction of contaminated groundwater without any reinjection of treated groundwater or injection of clean water, would produce a stagnation zone where contaminated groundwater may not migrate in any direction. This remedy, by mitigating the contaminated groundwater and eliminating the human exposure route, would be protective of human health and the environment. Within the stagnation zone, there would be the potential that exposure to contaminated groundwater could persist longer than in the cases of the other alternatives, if residential wells were to be used in this area. This situation could be alleviated if the extraction system were designed so as to minimize or eliminate the stagnation zone.

Alternative GE-3 also consists of groundwater extraction. However, the injection of clean water in the Cardinal Drive residential area would create a flushing action which would eliminate the stagnation zone discussed above and accelerate the remediation of the off-site contamination. There would be a possibility that the injection of water into the aquifer could cause some horizontal or downward vertical migration of contaminants. If this were to occur, and exposure to contaminated groundwater were to result, protection of human health and the environment would not be attained.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A and 2B	DISCHARGES TO TOMS RIVER
ALTERNATIVES GD-3A, 3B and 3C	DISCHARGES TO UPPER SAND AQUIFER

Risks that the public could be exposed to as a result of discharging the treated groundwater into the ocean, the river and back into the ground were calculated. They are as follows:

Discharge	Risk
Atlantic Ocean	2×10^{-7}
Toms River	2×10^{-8}
Upper Sand Aquifer	2×10^{-5}

The ocean and river discharge numbers were similar (approximately one order of magnitude difference) with river discharge producing a slightly lower risk. The risks ranged from two additional cancer deaths in one hundred thousand (10^{-5}) people exposed over a seventy-year period (aquifer discharge) to two in one hundred million (10^{-8}) people (river discharge). The calculations were based on human exposure via ingestion of contaminated water, ingestion of contaminated fish and dermal exposure. The calculations assumed the treatment process would meet the discharge limitations set by NJDEP.

The above risk numbers can be used to compare one discharge alternative to another. For the purpose of comparison, the risk due to exposure to the river discharge is 10 times less than the risk due to exposure to the ocean discharge, and 1000 times less than the risk due to exposure to the recharged water in the aquifer. This risk assessment for groundwater is based upon exposure to treated groundwater only. If an altered groundwater flow regime results in moving contaminated groundwater into adjacent areas or into the deeper aquifer, and thus, into private or municipal drinking water wells, the risks from exposure increase to unacceptable levels.

Among the various discharge alternatives for the Upper Sand Aquifer, it is expected that Alternative GD-3A, 30% Reinjection, would alter the flow regime less than Alternatives GD-3B or GD-3C, which include 100% recharge. This is due to the lesser volume of water being reinjected into the aquifer. Thus, the potential among the aquifer recharge alternatives, to spread contamination to drinking water wells is lowest for GD-3A. Therefore, GD-3A would be more protective of human health and the environment than GD-3B or GD-3C.

In summary, while the risk to human health of any of the discharge alternatives is within acceptable levels, the river discharge is the least risky, the ocean discharge is slightly more risky, while reinjection into the ground is the most risky.

COMPONENT 3:

ALTERNATIVES GT-1A to 1E	UTILIZING EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT
ALTERNATIVES GT-2A TO 2C	UTILIZING A NEW SEPARATE TREATMENT PLANT

All of the above treatment alternatives, if implemented to meet appropriate discharge levels, would be protective of human health and the environment. It should be noted, however, that treating the contaminated groundwater to the levels required for discharge to the Toms River would be most protective, treatment to levels required for ocean discharge would be second, and treatment to levels required for discharge to the aquifer would be the least protective.

2. COMPLIANCE WITH ARARS

This criterion addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements (ARARS) of other environmental statutes.

As discussed previously, Tables 5 and 6 list the ARARs for remediating the Upper Sand Aquifer and discharging treated groundwater back into the aquifer. Tables 3 lists the ARARs for the Atlantic Ocean discharge and Table 4 presents the TBC values for the Toms River discharge. Appendix B lists the additional location-specific and action-specific ARARs which may be required for various activities related to the extraction, treatment and discharge of the groundwater.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

This alternative would not result in attaining the Federal and State ARARs. Since the contaminants would continue to be present in the groundwater, the aquifer would not be in compliance with the standards required for a drinking water aquifer.

COMPONENT 1:

ALTERNATIVE GE-2	GROUNDWATER EXTRACTION
ALTERNATIVE GE-3	GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WATER

Both groundwater extraction scenarios would be implemented until ARARs (MCLs) are attained in the aquifer. If the groundwater extraction system designed under Alternative GE-2 results in a stagnation area, the ARARs would not be attained in this area. If Alternative GE-3 pushes contaminants downward into the lower aquifer, ARARs would not be attained in this area.

During the remedial design of the extraction system, a wetlands assessment will be performed in the marshland area to evaluate both the contamination present in this area and the potential impacts of the extraction system on the wetlands. This is required under Executive Order 11990, Protection of Wetlands. Also, the proposed remedial design will be reviewed to ensure that it is consistent with the New Jersey State Coastal Zone Management Program.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A and 2B	DISCHARGES TO TOMS RIVER

During the remedial design for any of the discharge scenarios, a floodplains assessment will be performed to ensure that the location of the holding basins will not violate the requirements of Executive Order 11988, Protection of Floodplains.

For any of these Alternatives: GD-1, GD-2A and GD-2B, contaminated groundwater would be treated to the levels required by the Clean Water Act and would therefore be expected to meet ARARs and TBC values for the discharges to the Toms River. These discharge criteria are considered to be protective of most aquatic organisms including species protected under the Marine Mammal Protection Act and the Endangered Species Act of 1973. As with the holding basins discussed above, the seepage network in Alternative GD-2B would be located such that any floodplains protection requirements would be met.

COMPONENT 2:

ALTERNATIVES GD-3A, 3B and 3C DISCHARGES TO UPPER SAND AQUIFER

Any treated groundwater which would be recharged into the Upper Sand Aquifer (a public drinking water source) would be treated to drinking water standards and would therefore be expected to meet ARARs. Potentially for Alternative GD-3A and most likely for Alternatives GD-3B and GD-3C, if the reinjected groundwater moves contamination into areas where the contamination does not presently exist, or into the deeper aquifer through the semi-confining unit, groundwater ARARs would not be attained in these areas.

Additionally, any requirements under the Underground Injection Control Regulations for the injection of treated groundwater into a drinking water source would be met for these alternatives.

COMPONENT 3:

ALTERNATIVES GT-1A TO 1E	UTILIZING EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT
ALTERNATIVES GT-2A TO 2C	UTILIZING A NEW SEPARATE TREATMENT PLANT

For each of the treatment scenarios discussed in Alternatives GT-1A to 1E and GT-2A to 2C, the treatment plant would be expected to meet the appropriate discharge criteria for each discharge alternative (Atlantic Ocean, Toms River or Upper Sand Aquifer.) To ensure that the treatment plant would function as required, pilot studies would be conducted to develop the operating and design criteria to meet the necessary degree of treatment. Since the ARARs for ocean discharge are less stringent, they are more likely to be met than the ARARs for the Toms River and Upper Sand Aquifer discharges.

3. LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

Performance of only site monitoring activities without taking any action to control migration of groundwater contamination would not provide for long-term effectiveness in protecting human health and the environment. There would continue to be groundwater contamination which poses a threat to public health. The magnitude of the public health and environmental risks would remain unchanged and potentially increase, if contaminant leaching from sources were to increase.

COMPONENT 1:

ALTERNATIVE GE-2	GROUNDWATER EXTRACTION
ALTERNATIVE GE-3	GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WA

For both of these alternatives, the groundwater contamination would be reduced to levels which are protective of public health. However, for both scenarios, there is some degree of uncertainty that all of the contamination will be remediated. If a stagnation zone is formed in the Cardinal Drive residential area in Alternative GE-2, some groundwater contamination would be left indefinitely and long-term effectiveness would not be attained. The stagnation zone in Alternative GE-2 would be eliminated in Alternative GE-3 by flushing with clean water. However, this flushing action may push contaminants downward into the lower aquifer again placing human health and the environment at risk.

Alternative GE-2 would be expected to be more effective in achieving long-term protection than Alternative GE-3, if the stagnation zone were eliminated. As stated previously, this could be accomplished by increasing the number of wells.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A and 2B	DISCHARGES TO TOMS RIVER
ALTERNATIVES GD-3A, 3B and 3C	DISCHARGES TO UPPER SAND AQUIFER

Alternatives GD-1, GD-2A and 2B would provide long-term effectiveness. Alternatives GD-3A, 3B and 3C may not provide long-term effectiveness if the recharge of treated groundwater spreads contamination either vertically or horizontally to other areas.

There is a greater likelihood that contamination may be pushed horizontally and/or vertically into uncontaminated areas (off site or into a deeper zone of the aquifer) in Alternatives GD-3B and GD-3C than in Alternative GD-3A. Thus, Alternatives GD-3B and GD-3C are the least likely to attain long-term protection of human health.

COMPONENT 3:

ALTERNATIVE GT-1A TO 1E UTILIZING EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT
ALTERNATIVE GT-2A TO 2C UTILIZING A NEW SEPARATE TREATMENT PLANT

Alternatives GT-1A, GT-1B, GT-1C, GT-2A and GT-2B (ocean discharge) are expected to provide the same degree of long-term effectiveness. The alternatives utilize existing technologies which have been used frequently for treatment of industrial and hazardous wastes. All of these treatment alternatives are reliable and present no major operational problems provided proper maintenance is performed.

It is less certain whether Alternatives GT-1D, GT-1E and GT-2C (river or aquifer discharge) can provide the same degree of long-term effectiveness as the other treatment alternatives discussed above. Pilot studies will be required to develop the design criteria for meeting the discharge limitations for the river and aquifer.

4. REDUCTION OF TOXICITY, MOBILITY OR VOLUME

This criterion refers to the anticipated performance of the treatment technologies, with respect to these parameters, that a remedy may employ.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

By allowing the contaminated groundwater to continue to migrate off site and into the Toms River, this alternative would not reduce the toxicity, mobility or volume of contamination either on or off site. The sources would continue to contribute to the groundwater contamination and therefore, the volume of contaminants in the groundwater may actually increase.

COMPONENT 1:

ALTERNATIVE GE-2 GROUNDWATER EXTRACTION
ALTERNATIVE GE-3 GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WAT

These alternatives do not reduce toxicity. However, both of these alternatives significantly reduce the volume of contaminated groundwater by extracting it from the ground and eliminating further migration of contaminants. Alternative GE-2 attains the greatest reduction of contaminants except for the stagnation zone because no reinjection of treated water occurs. Assuming that the stagnation zone associated with Alternative GE-2 is eliminated or minimized, Alternatives GT-2 and GT-3 would be effective in reducing contaminants. However, since reinjection may produce a downward migration of contaminants, this alternative may be potentially less effective.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A AND 2B	DISCHARGES TO TOMS RIVER
ALTERNATIVES GD-3A, 3B AND 3C	DISCHARGES TO UPPER SAND AQUIFER

This criterion is generally not applicable to Alternatives GD-1, GD-2A and GD-2B, as these discharge options do not reduce toxicity, mobility or volume of contaminants. Alternatives GD-3A, GD-3B and GD-3C include returning the treated groundwater to the Upper Sand Aquifer and in these cases, some low residual levels of contaminants would be returned to the aquifer system and the quantity or volume of contaminants in the aquifer would be greater than that for the alternatives which do not include recharge. Alternatives GD-3B and GD-3C place the greatest amount of contaminants back into the aquifer because 100% of the treated groundwater is recharged.

COMPONENT 3:

ALTERNATIVES GT-1A TO 1E	UTILIZING EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT
ALTERNATIVES GT-2A TO 2C	UTILIZING A NEW SEPARATE TREATMENT PLANT

All of the above treatment plant alternatives would reduce the toxicity, mobility and volume of waste by removing contaminants from the groundwater and treating them.

If the groundwater were treated to nondetectable levels, the toxicity, mobility and volume of waste in the groundwater would be reduced to the greatest extent. Discharge to the Toms River requires the second most stringent levels; the aquifer discharge scenario has the third most stringent requirements, with the ocean discharge criteria being the least stringent.

5. SHORT-TERM EFFECTIVENESS

This criterion addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

This alternative would take no time to implement as the monitoring wells which would be used currently exist. This alternative presents no short-term risks to on-site workers or the community, however, it provides little or no protection to human health and the environment.

COMPONENT 1:

ALTERNATIVE GE-2	GROUNDWATER EXTRACTION
ALTERNATIVE GE-3	GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WATER

Both of these alternatives reduce the threat to public health in generally the same length of time, although Alternative GE-2 would take longer than Alternative GE-3 by not including some form of groundwater recharge. Also, each alternative takes approximately the same amount of time to implement.

Short-term risks to workers are associated with installation of the collection system and through direct contact pathways with contaminated water resulting from pipeline leaks and normal construction hazards during remedial action. These risks can be mitigated through the use of appropriate controls and adherence to proper health and safety protocols during construction activities.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A AND 2B	DISCHARGES TO TOMS RIVER
ALTERNATIVES GD-3A, 3B AND 3C	DISCHARGES TO UPPER SAND AQUIFER

Alternative GD-1 would require the least time to implement since the ocean discharge pipeline is already in existence.

Alternatives GD-2A and 2B would require a small amount of time to construct the pipeline or seepage network to the Toms River.

Alternatives GD-3A, 3B and 3C would require the installation of reinjection wells or infiltration basins. Piping systems to transport the treated groundwater to the reinjection wells or infiltration basins would also have to be designed and constructed. These discharge alternatives would require significantly more time to implement than either Alternatives GD-1, GD-2A or GD-2B.

It should be noted that the length of time required to implement a remedy for this operable unit is dependent upon the length of time needed to perform pilot studies and design and construct the treatment plant (as discussed in Component 3.) Any of the discharge alternatives can be implemented concurrently with the treatment alternatives.

The short-term risks to workers for Alternatives GD-2A, GD-2B, GD-3A, GD-3B and GD-3C include those presented by normal construction hazards during the construction and operation activities. The risks can be mitigated through adherence to proper health and safety protocols.

COMPONENT 3:

ALTERNATIVES GT-1A TO 1E	UTILIZING THE EXISTING CIBA-GEIGY TREATMENT PLANT
ALTERNATIVES GT-2A TO 2C	UTILIZING A NEW SEPARATE TREATMENT PLANT

The following lists the estimated times required to implement each of the treatment and discharge options for Alternatives GT-1 and GT-2.

Ocean-Existing Plant	(GT-1A, 1B, 1C)	34-36 months
Ocean-New Plant	(GT-2B)	38-44 months
Toms River-Existing Plant	(GT-1D, 1E)	38-44 months
Toms River-New Plant	(GT-2C)	48-54 months

It is noted that the alternatives generally will require between 3 and 4.5 years to implement. Alternatives GT-1A, 1B and 1C require the least amount of time to implement. Although the plant is currently built and operating, pilot studies for an ocean discharge would be required before plant modifications could be designed and constructed.

Pilot studies would also be required for Alternatives GT-2A and 2B for discharge to the Atlantic Ocean. A new plant would then have to be designed and constructed before any groundwater remediation would occur.

The discharge criteria for the Toms River and Upper Sand Aquifer are more stringent than for the ocean discharge criteria. Due to the additional treatment processes required to meet river/aquifer discharge criteria, the pilot studies required for the river discharge Alternatives GT-1D, 1E and 2C would be more extensive than for the ocean discharge Alternatives GT-1A, 1B, 1C and 2B and therefore the river discharge alternatives would require a longer time to implement.

For all treatment plant alternatives, short-term risks to workers include those presented by normal construction hazards during the construction and operation and maintenance of the plant. The risks can be mitigated through adherence to proper health and safety protocols.

6. IMPLEMENTABILITY

This criterion addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

This alternative, requiring only groundwater monitoring, is the simplest to implement. It has no construction or land requirements. The monitoring wells which would be utilized in this alternative are currently in existence and would require no construction activities.

COMPONENT 1:

ALTERNATIVE GE-2 GROUNDWATER EXTRACTION
ALTERNATIVE GE-3 GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WATER

Alternatives GE-2 and GE-3 can be implemented without construction difficulties and in a relatively short period of time. There is some concern related to potential operation and maintenance problems associated with the injection of clean water into the aquifer under Alternative GE-3. Therefore, Alternative GE-2 is believed to be the more implementable of the two alternatives, since no reinjection is included in this scenario.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A AND 2B	DISCHARGES TO TOMS RIVER

It is expected that the discharge alternatives for the ocean and river are implementable. The ocean discharge pipeline currently exists and is in use, and the construction materials for the discharge to the Toms River are available, as well as the land required for construction. However, if at some future time, the use of the ocean discharge pipeline is banned by law, the ocean discharge alternative would not be implementable.

COMPONENT 2:

ALTERNATIVES GD-3A, 3B AND 3C	RECHARGE TO UPPER SAND AQUIFER

The construction materials and land required for the injection and reinjection wells and infiltration basins used in these alternatives are available. There is some concern that recharging the large volume of water into the aquifer in Alternatives GE-3B and GE-3C will create operation and maintenance problems. The concern is due to the possibilty of clogging from metals precipitation and bacterial growth in the wells and basins and in the aquifer. Therefore, since Alternative GD-3A includes only 30% reinjection, this alternative is believed to be more implementable than Alternatives GD-3B or GD-3C.

COMPONENT 3:

ALTERNATIVES GT-1A TO 1E	UTILIZING THE EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT
ALTERNATIVES GT-2A TO 2C	UTILIZING THE NEW SEPARATE TREATMENT PLANT

Alternatives GT-1A, GT-1B, GT-1C, GT-2A and GT-2B, (ocean discharge) can be readily implemented. The proposed treatment technologies and equipment required for construction of any treatment plant modifications or additions are available.

There is less certainty regarding the implementability of Alternatives GT-1D, GT-1E and GT-2C (treatment with discharge to the Toms River or Upper Sand Aquifer). Pilot studies will be required prior to implementation of the groundwater treatment system to develop the design criteria to ensure attainment of the discharge criteria. The requirements for discharge to the Upper Sand Aquifer are less stringent than the requirements for discharge to the Toms River, and thus, slightly more implementable.

7. COST

This criterion includes estimated capital, operation and maintenance costs and net present worth costs. The costs estimates are summarized in Tables 10A, 10B and 10C, respectively, for Component 1, the Extraction Alternatives, Component 2, the Discharge Alternatives and Component 3, the Treatment Alternatives. Detailed information regarding the assumptions which were made in developing these costs is presented in the groundwater-modeling and treatment documents previously referenced (CDM, April 1989).

For Component 1, the No Further Action with Monitoring Alternative is the least costly alternative with a present worth value of approximately $5.2 million. Alternative GE-2, Groundwater Extraction only, would cost approximately $10.0 million. However, if the stagnation zone were to be eliminated in this alternative, the cost would increase to approximately $13.5 million. Alternative GE-3, with some reinjection would cost approximately $13.2 million.

For the Component 2 alternatives, the cost of discharging to the Atlantic Ocean via the existing pipeline is estimated at $3.7 million. The costs of discharging to the Toms River are estimated at $864,000 for discharge through a pipe, versus $1.7 million for discharge via a seepage network.

For the alternatives related to discharge to the Upper Sand Aquifer, the cost for Alternative GD-3A (with 30% reinjection) is estimated to be $22.1 million. Alternative GD-3B (100% recharge using reinjection) is estimated to be $24.2 million and Alternative GD-3C (with 100% recharge using reinjection wells and infiltration basins) is estimated to be $20.0 million.

For the Component 3 alternatives, the present worth values to treat the groundwater are as follows:

Existing CIBA-GEIGY Wastewater Treatment Plant		New On-Site Treatment Plant	
GT-1A (ocean)	$ 58,921,000	GT-2A (ocean)	$ 66,403,0
GT-1B (ocean)	$ 63,909,000	GT-2B (ocean)	$ 71,632,0
GT-1C (ocean)	$ 58,921,000	GT-2C (river/aquifer)	$167,344,0
GT-1D (river/aquifer)	$155,099,000	GT-2D (nondetect)	$182,315,0
GT-1E (river/aquifer)	$150,115,000		
GT-1F (nondetect)	$158,136,000		

This information indicates that the costs to treat the groundwater for discharge to the ocean range from approximately $59 million to $72 million. The costs for Toms River or Upper Sand Aquifer discharge range from approximately $150 million to $167 million. The main difference in costs between the Atlantic Ocean and Toms River/Upper Sand Aquifer scenarios is due to the reverse osmosis and activated carbon units which are required to remove additional total dissolved solids and residual organic compounds from the groundwater.

The reverse osmosis unit would result in high operation and maintenance costs due to the production of a large sidestream flow which is concentrated in total dissolved solids. The sidestream would be first treated on site to reduce the volume and the remaining concentrated stream will be disposed off site.

It is noted that if the existing facility were modified to provide treatment to nondetectable levels, the cost for modifying the existing plant is estimated to increase from approximately $150 million (Alternative GT-1E) to $158 million. Similarly, the cost for building a new plant to achieve nondetectable levels is estimated to increase from approximately $167 million (Alternative GT-2C) to $182 million.

8. STATE ACCEPTANCE

This criterion addresses the concern and degree of support that the state government has expressed regarding the remedial alternatives being evaluated.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

This alternative would not adequately reduce the public health and environmental risks posed by the contaminated groundwater. In addition, neither Federal or State ARARs would be met. Therefore, the State would not support this alternative.

COMPONENT 1:

ALTERNATIVE GE-2 GROUNDWATER EXTRACTION
ALTERNATIVE GE-3 GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WATER

NJDEP concurs that the contaminated groundwater should be extracted and treated. The State has indicated that it would not want reinjected water to force contaminants into the lower aquifer.

COMPONENT 2:

ALTERNATIVE GD-1	DISCHARGE TO ATLANTIC OCEAN
ALTERNATIVES GD-2A and 2B	DISCHARGES TO TOMS RIVER

The state would accept any of these discharge alternatives provided all discharge criteria are met.

COMPONENT 2:

ALTERNATIVES GD-3A, 3B and 3C RECHARGE TO UPPER SAND AQUIFER

The NJDEP would accept these alternatives, only if none of the reinjected groundwater would migrate off site or into deeper subsurface zones. All reinjected water would have to be recaptured downgradient by the extraction wells.

COMPONENT 3:

ALTERNATIVES GT-1A TO 1E	UTILIZING THE EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT
ALTERNATIVES GT-2A to 2C	UTILIZING THE NEW SEPARATE TREATMENT PLANT

The NJDEP would accept any of these treatment alternatives. The NJDEP agrees with EPA that pilot studies will be required to develop the design criteria for treating the contaminated groundwater to the stringent levels required for ocean, Toms River, or aquifer discharge.

9. COMMUNITY ACCEPTANCE

This section summarizes the public's general response to the alternatives described in the Proposed Remedial Action Plan, the RI/FS reports and the weekly meetings held through the extended public comment period. Specific responses to public comments are addressed in the Responsiveness Summary which is an attachment to this document.

COMPONENT 1:

ALTERNATIVE GE-1 NO FURTHER ACTION WITH MONITORING

This alternative would not be acceptable to the public, as the threat to public health and the environment will not be reduced. Contamination would continue to spread and could contaminate additional wells.

COMPONENT 1:

ALTERNATIVE GE-2 GROUNDWATER EXTRACTION
ALTERNATIVE GE-3 GROUNDWATER EXTRACTION AND INJECTION OF CLEAN WATER

The public is in general agreement that the contaminated groundwater should be extracted and treated.

COMPONENT 2:

ALTERNATIVE GD-1 DISCHARGE TO ATLANTIC OCEAN

The public, particularly those who live along the shore, is adamantly opposed to discharging the treated groundwater to the ocean.

COMPONENT 2:

ALTERNATIVES GD-2A AND GD-2B DISCHARGES TO TOMS RIVER

Some of the public is against discharging the treated groundwater to the Toms River, however, for the majority of the public, this is preferable to the ocean discharge.

As described in a previous section of this document, the majority of the public favors a seepage network for discharging the treated groundwater into the Toms River rather than a single pipeline.

COMPONENT 2:

ALTERNATIVES GD-3A, 3B AND 3C RECHARGE INTO UPPER SAND AQUIFER

Many people prefer this alternative and would like the water reinjected back into the aquifer. However, some members of the public who live adjacent to the site share EPA's concerns regarding the possibility of spreading contamination in other areas such as Pine Lake Park and into deeper subzones of the aquifer. Additionally, the water companies in the area are concerned that reinjection may spread contamination to their wells.

COMPONENT 3:

ALTERNATIVES GT-1A TO 1E UTILIZING EXISTING CIBA-GEIGY TREATMENT PLANT
ALTERNATIVES GT-2A TO 2C UTILIZING THE NEW SEPARATE TREATMENT PLA

The public expressed major concerns related to the level of treatment achieved, the point of discharge, and whether the groundwater would be treated separately or combined with the

CIBA-GEIGY process waste. The public wants the groundwater to be treated to the most stringent standards possible and want the groundwater treated separately from the process waste. In addition, as discussed in an earlier section of this document, the public indicated a strong preference for using holding basins for the treated groundwater prior to discharge.

SELECTED REMEDY

The EPA has been explicitly directed by Congress in Section 121(b) of CERCLA, as amended, to select remedial actions which utilize permanent solutions and alternative treatment technologies or resource recovery options to the maximum extent practicable. In addition, the Agency is to prefer remedial actions that permanently and significantly reduce the mobility, toxicity or volume of site wastes.

A) Description of the Selected Remedy

After careful review and evaluation of the alternatives presented in the Feasibility Study as achieving the best balance of all evaluation criteria, on June 23, 1988, EPA presented that extraction and treatment of the contaminated groundwater and discharge of the cleansed water to the Atlantic Ocean was the best alternative. Since the risks to public health and the environment from both an ocean or river discharge were low, EPA indicated that a river discharge would also be an acceptable alternative.

Due to the strong concerns expressed by the public regarding the ocean discharge and the public's request to explore other alternatives and the existing alternatives in greater detail, EPA extended the public comment period to November 4, 1988 and conducted additional studies and evaluations, the results of which were presented to members of the public, CIBA-GEIGY and State and local governments. The input which EPA received during the public comment period is presented in the Responsiveness Summary, which accompanies this report.

Based on the results of supplemental studies and evaluations and the information contained in the original Feasibility Study, and input received during the public comment period, EPA has chosen the following alternatives for the remedy for the first operable unit at the CIBA-GEIGY site:

°	Component 1	GE-2	Groundwater Extraction,
°	Component 2	GD-2A	Discharge to the Toms River by Pipeline
			and
°	Component 3	GT-1E	CIBA-GEIGY Wastewater Treatment Plant-Treatment of Contaminated Groundwater Only

As indicated above, EPA's selected remedy is essentially the same as the proposed remedy with the exception that the treated groundwater will be discharged to the Toms River rather than the Atlantic Ocean. EPA believes that there are several considerations and factors that make the selected remedy, which includes a river discharge, a unique determination for the site. Currently, the CIBA-GEIGY ocean outfall is the only direct industrial discharge from a chemical manufacturing facility in the State of New Jersey. EPA is aware that there is pending state legislation to prohibit such discharges. Furthermore, in late 1988, EPA under former Administrator Lee Thomas, issued the Agency's National Coastal and Marine Policy recognizing the serious degradation of the nation's coastal and marine waters. One of the goals of this policy is to minimize the use of coastal and marine waters for waste disposal. Also, the federal Ocean Dumping Ban Act prohibits new permits for ocean dumping for industrial and acid wastes by 1991. In addition, within the last two years, two major industries, namely, Allied Chemical and E.I. du Pont de Nemours & Company have voluntarily discontinued their practices of ocean dumping industrial wastes. As indicated in an earlier section of this document, CIBA-GEIGY also intends to terminate the use of its existing ocean outfall for process wastes by December 31, 1991.

It is due to primarily these circumstances and events as well as the opposition and concerns voiced by the general public that EPA has decided not to include ocean discharge as part of the selected remedy for the first operable unit of the CIBA-GEIGY site.

The major components of the Remedial Action are as follows:

- Sealing contaminated residential irrigation wells in the Cardinal Drive area to prevent human exposure to contaminated groundwater.
- Installation of an extraction well system both on and off site to capture the contaminated groundwater in the

off-site areas and stop migration of contaminated groundwater at the property line. The system will be designed such that the stagnation zone produced in Alternative GE-2 will be eliminated or minimized to the maximum extent practicable. In addition, the system will be designed to limit the downward vertical migration of contaminants and protect the semiconfined aquifer by creating an upflow gradient. The exact design of the extraction system will be determined during the design phase of the project. The quality of the deeper aquifer will also be evaluated during the design phase.

- Extraction of contaminated groundwater at a rate estimated between 2.7 and 4 MGD until the federal and state cleanup standards listed in Tables 5 and 6 are met to the maximum extent that is technically practicable.
- After extraction, treatment of the contaminated groundwater separately from process wastewater in the existing CIBA-GEIGY wastewater treatment plant. This will be accomplished by modifying the wastewater treatment plant to accommodate only the groundwater flow. Any process wastewater would be treated in a separate facility. However, during the pilot and design phases an evaluation for modifying the existing CIBA-GEIGY wastewater treatment plant to accommodate the (hydraulically) separate treatment of both the groundwater and process wastewater will be made to determine if any cost savings can be realized. The contaminated groundwater will be treated to the discharge levels required by the NJDEP, and determined to be practicable based on pilot studies; the levels will be developed based on the Effluent Limitations Guidelines for the Organic Chemicals and Plastics and Synthetic Fibers Category (40 CFR Parts 414 and 416) and the 1988 proposed New Jersey State Surface Water Quality Standards for discharge to the Toms River (refer to Table 4).
- Conduct of pilot studies to confirm the practicability of achieving the discharge levels and to develop the design and operating criteria for the treatment processes and design modifications to the existing CIBA-GEIGY treatment plant which will be required to meet the Toms River discharge criteria. If based on the results of pilot studies, EPA determines that the above-mentioned effluent standards are technically impracticable or cannot be achieved, then an evaluation will be made to determine the standards that can be achieved.

- After treatment, the groundwater will be retained in basins to allow monitoring of residual levels prior to discharge through a pipeline to the Toms River. The use of a diffuser for the discharge will be evaluated during the remedial design phase.

Additional activities which will be performed as part of this ROD are the following:

- Monitoring of the Toms River will be performed during the design phase of this project. The monitoring will provide a baseline for current water quality in the river upstream, downstream and adjacent to the site. The data generated from the monitoring effort will be used to supplement existing information in assessing the current impact of the contaminated groundwater on the Toms River. Monitoring will continue during the implementation of the remedial action to evaluate the effects of the extraction system and discharge over time.
- Groundwater monitoring will be performed while the extraction system and treatment plant modifications are being designed and will continue during the implementation of the remedial action.

The purpose of the river and groundwater monitoring program as indicated above is twofold:

1. The river monitoring will provide a baseline to which the effects of all future activities can be compared. By obtaining data on present river water quality conditions, the effects of the extraction system, when operational, and river discharge can be measured and evaluated.
2. The groundwater and river monitoring program will generate information to ensure that, while the pilot studies and treatment plant design are being performed, the groundwater contamination problem is not migrating further and the quality of the Toms River is not deteriorating. If it appears that the contamination may be spreading either laterally or vertically, the option may exist to pump and treat the contaminated groundwater and discharge it to the ocean.

The costs (expressed as present worth values) associated with the selected alternatives are the following:

Alternative GE-2 Groundwater Extraction (modified to eliminate stagnation zones and enhance upflow gradients)	$ 13,500,000
Alternative GD-2A Discharge to Toms River by pipe	$ 900,000
Alternative GT-1E (CIBA-GEIGY Wastewater Treatment Plant for Discharge to Toms River)	$150,100,000
Total Estimated Cost of Remedy	$164,500,000

It is noted that the above values do not include the costs for river monitoring. It is further noted that the cost may be reduced by up to $4 million by using the 75 million gallon emergency reservoir in place of the two holding tanks.

Pre-design work including, but not limited to pilot studies and preliminary engineering are estimated to take approximately 8 months to complete. Design of the selected remedy is estimated to take an additional 12 months. The time required to construct the remedy is estimated to be approximately 18 to 24 months. Therefore, the estimated timeframe to implement the selected remedy is 38 to 44 months.

B) Future Work

A Supplemental Remedial Investigation will be required to characterize adequately the nature and extent of the contaminant sources, both known and suspected, and to study the Lower Sand Aquifer further. Upon completion of the Supplemental Remedial Investigation, a Feasibility Study will be conducted to develop and evaluate remedial alternatives. A subsequent ROD(s), which will document the selection of a remedy for the control of the sources of contamination and will address the remediation of the Lower Sand Aquifer (if necessary), will be prepared.

THE STATUTORY DETERMINATIONS

Protection of Human Health and the Environment

The selected remedy is protective of human health and the environment in that the contaminated groundwater will be controlled and treated on site and remediated in off-site areas. In addition, the remedy will significantly reduce the toxicity and volume of contaminants in the groundwater and prevent further degradation of groundwater quality in the Upper Sand Aquifer. It will mitigate the risk to public health by eliminating the principal threat posed by the site, i.e., ingestion of contaminated groundwater from public and residential wells.

The contaminated groundwater will be treated to the required limits before discharging to the Toms River, thereby reducing the toxicity and volume of contaminants. The extraction and treatment of the contaminated groundwater will produce no short-term risk to public health and the environment.

Attainment of Applicable or Relevant and Appropriate Requirements

During development of the Feasibility Study, applicable or relevant and appropriate requirements, (ARARs) and to be considereds (TBCs) were established for groundwater remediation based on current EPA guidance.

Location-Specific

The remedy will comply with all location-specific ARARs. The floodplain will be evaluated during the designs of the extraction system and the holding basins. As required by Executive Order 11988, Protection of Floodplains, the remedial design will include efforts to minimize potential harm and avoid adverse effects to the floodplain area.

The wetlands will also be evaluated during the design of the groundwater extraction system. Executive Order 11990, Protection of Wetlands, requires that actions be taken to minimize the destruction, loss or degradation of wetlands.

The discharge of the treated groundwater will comply with all requirements of the Endangered Species Act of 1973 and the Marine Mammal Protection Act. EPA has consulted with the Department of Commerce (National Oceanic and Atmospheric Administration) (NOAA) on the proposed remedies and NOAA has concurred that the remedy is protective of endangered or threatened species.

During the remedial design, the requirements of the New Jersey State Coastal Management Program will be evaluated to ensure that remedial activities are consistent with the Coastal Management Program.

Also during the remedial design, the site and the remedial action will be reviewed to determine the potential impacts to cultural resources which could result from the remedial activities as required under National Historic Preservation Act.

Action-specific

The remedy will comply with all Clean Water Act requirements for discharge of treated groundwater to the Toms River. The groundwater will be treated to the levels listed in Table 4. These values were derived from the proposed New Jersey State Water Quality Standards and are TBCs. In anticipation of promulgation of the proposed standards, EPA has chosen to use them in developing the Toms River discharge criteria.

Chemical-specific

The aquifer will be remediated to the New Jersey MCLs listed in Tables 5 and 6. These standards are applicable requirements for a drinking water aquifer.

Cost Effectiveness

EPA believes that the Selected Remedy affords the highest overall effectiveness proportionate to its cost. The Selected Remedy will be designed to maximize the removal of contaminant mass from the aquifer. The groundwater will then be treated to the levels required for discharge to the Toms River. The costs of treatment for a river discharge are greater than for ocean discharge because the river discharge criteria are more stringent than ocean discharge criteria. Thus, a greater proportion of pollutants are removed. EPA believes that the benefits in terms of the total volume of contaminants removed justify the added costs involved.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

This remedy represents the best balance of the nine criteria and is determined to be the most appropriate remedy for the site at this time. It utilizes permanent solutions by extracting and treating the contaminated groundwater and uses alternative treatment technologies to the maximum extent practicable.

The groundwater treatment will reduce the contaminants of concern to health protective levels. After treatment of the off-site groundwater is complete, the aquifer will no longer present potential future risk to the public health; neither monitoring nor management will be required.

The groundwater at the site will continue to become contaminated as long as the sources of contamination remain. Therefore, the extraction wells pumping the on-site groundwater contamination will continue until the contamination sources and the groundwater are remediated. The sources will be investigated and remediated in the second operable unit.

Preference for Treatment as a Principal Element

The Selected Remedy satisfies the statutory preference for remedies employing treatment that permanently and significantly reduces the toxicity, mobility or volume of hazardous substances.

The Selected Remedy includes the installation and operation of extraction wells for contaminant recovery. Contaminated groundwater pumped from the extraction wells will be treated in the existing CIBA-GEIGY treatment plant before being discharged to the Toms River. This pumping and treatment is expected to reduce permanently and significantly the toxicity, mobility, and volume of the hazardous substances in the groundwater at the site and in the off-site areas.

TABLE 1

TOTAL "NO ACTION" CARCINOGENIC RISKS AND CHRONIC HAZARD EVALUATION FOR RESIDENTIAL EXPOSURE ROUTES

Exposure Route	Carcinogenic Risk	Total Chronic Hazard[a]
Ingestion of Water From a Residential Well	1 x 10^{-2}	4 x 10
Dermal Absorption of Water From a Residential Well	1 x 10-5	1 x 10-2
Inhalation Exposure From Residential Well Water	5 x 10-5	8 x 10-1

The total carcinogenic risk per million people exposed is: 1 x 10^{-2}.

The total chronic hazard is: 4 x 10.

[a] The chronic hazard is the ratio of the amount of a chemical to which an individual might be exposed to the amount of the chemical that will not cause any adverse effect. A hazard index that is less than 1.0 indicates that no adverse health impacts would be expected.

TABLE 2

TOTAL "NO ACTION" CARCINOGENIC RISKS AND CHRONIC HAZARD EVALUATION FOR RECREATIONAL EXPOSURE ROUTES

Exposure Route	Carcinogenic Risk	Total Chronic Hazard[a]
Ingestion of Surface Water From the Toms River	4×10^{-9}	7×10^{-6}
Ingestion of Marshland Sediment	1×10^{-6}	6×10^{-6}
Ingestion of Fish Which Inhabit the Toms River	2×10^{-6}	4×10^{-2}
Dermal Absorption of Surface Water From the Toms River	2×10^{-8}	7×10^{-5}
Dermal Absorption of Contaminants From Marshland Sediment	6×10^{-8}	3×10^{-5}
Inhalation of Contaminated Air From the Toms River	2×10^{-10}	4×10^{-6}
Inhalation of Contaminated Air in the Marshland	5×10^{-6}	8×10^{-3}

The total carcinogenic risk per million people exposed is: 8×10^{-6}.

The total chronic hazard is: 5×10^{-2}.

[a] The chronic hazard is the ratio of the amount of a chemical to which an individual might be exposed to the amount of the chemical that will not cause any adverse effect. A hazard index that is less than 1.0 indicated that no adverse health impacts would be expected.

TABLE 3

ACTION-SPECIFIC ARARs

DISCHARGE CRITERIA FOR THE ATLANTIC OCEAN (MASS UNITS)+

POLLUTANT	4 MGD DISCHARGE TO THE ATLANTIC OCEAN (kg/day) average/maximum
Benzene	0.561/ 2.060
Chlorobenzene	0.227/ 0.425
Chloroform	0.318/ 0.698
Chlorinated Benzenes	*231
1,2-Dichloroethane	1.030/ 3.200
Carbon Tetrachloride	0.273/ 0.576
Ethylbenzene	0.485/ 1.640
Toluene	0.394/ 1.219
Dichloroethenes	*3400
1,1-Dichloroethene	0.243/ 0.379
Trans-1,2-Dichloroethene	0.318/ 0.819
Tetrachloroethene	0.334/ 0.849
Trichloroethene	0.318/ 0.819
1,1,1-Trichloroethene	0.318/ 0.819
Methylene Chloride	0.607/ 1.350
1,2-Dichlorobenzene	1.170/ 2.470
1,3-Dichlorobenzene	0.470/ 0.667
1,4-Dichlorobenzene	0.227/ 0.425
Total Dichlorobenzenes	*29.9
Bis(2-Ethylhexyl)Phthalate	1.560/ 4.230
Naphthalene	0.334/ 0.895
Nitrobenzene	0.409/ 1.030
Phenol	0.227/ 0.394
1,2,4-Trichlorobenzene	1.030/ 2.120
Vinyl Chloride	1.580/ 4.060
Cadmium	1.516/ 3.033
Chromium Trivalent	*156
Chromium Hexavalent	*89.5
Total	3.030/ 6.060
Copper	*5.19
Lead	2.270/ 4.550
Nickel	11.40 /22.70
Zinc	7.580/15.20
Arsenic	3.030/ 6.060
Pentavalent	*23.3
Trivalent	*64.4
Mercury	0.045/ 0.091
Selenium	*96.6
Iron	22.7 /45.5
TSS	-
TDS	-
Petroleum Hydrocarbons (mg/l)	10 /15
Acute toxicity (LC50)-%eff	*50
Chronic Toxicity (NOEC)-%eff	*8.5
pH Standard Units	6 minimum - 9 maximum

A minimum 85% TOC removal is required when influent TOC >100 mg/l. When influent TOC is <100 mg/l, a maximum TOC effluent limitation of 15.0 mg/l is required.

+Technology based discharge criteria except where noted.

*Federal Water Quality Criteria

TABLE 3A

ACTION-SPECIFIC ARARs

DISCHARGE CRITERIA FOR THE ATLANTIC OCEAN (CONCENTRATION UNITS)

(Revised December 9, 1988)

POLLUTANT	DISCHARGE TO THE ATLANTIC OCEAN (ug/l)
*Benzene	37.0
*Chlorobenzene	15.0
*Chloroform	21.0
+Chlorinated Benzenes	129.0
*1,2-Dichloroethane	68.0
*Carbon Tetrachloride	18.0
*Ethylbenzene	32.0
*Toluene	26.0
+Dichloroethenes	224,000.0
*1,1-Dichloroethene	16.0
*Trans-1,2-Dichloroethane	21.0
*Tetrachloroethene	22.0
*Trichloroethene	21.0
*1,1,1-Trichloroethane	21.0
*Methylene Chloride	40.0
*1,2-Dichlorobenzene	77.0
*1,3-Dichlorobenzene	31.0
*1,4-Dichlorobenzene	15.0
*Total Dichlorobenzenes	1,970.0
*Bis(2-Ethylhexyl)Phthalate	103.0
*Naphthalene	22.0
*Nitrobenzene	27.0
*Phenol	15.0
*1,2,4-Trichlorobenzene	68.0
*Vinyl Chloride	104.0
*Cadmium	100.0
Chromium	
+Trivalent	10,300.0
+Hexavalent	50.0
*Total	500.0
+Copper	2.9
+Lead	5.6
+Nickel	8.3
+Zinc	86.0
Arsenic	
+Pentavalent	13.0
+Trivalent	36.0
+Mercury	0.025
+Selenium	54.0
*Iron	1,500.0
TSS (mg/l)	-
TDS (mg/l)	-
Petroleum Hydrocarbons (mg/l)	10.0
Acute Toxicity (LC50)-%eff	>50.0
Chronic Toxicity (NOEC)-%eff	>8.5
pH Standard Units	6.0 - 9.0

*Technology based discharge criteria.
+Federal Water Quality Criteria.

TABLE 4

PROPOSED DISCHARGE CRITERIA FOR THE TOMS RIVER (MASS UNITS)** TO BE CONSIDERED

POLLUTANT	4 MGD DISCHARGE TO THE TOMS RIVER (kg/day)	
WATER QUALITY BASED	DIFFUSER	NO DIFFUSER
Benzene	0.1704	0.0151
Chlorobenzene	0.6816	0.0606
Chloroform	0.0324	0.0029
1,2-Dichloroethane	0.3408	0.0303
Carbon Tetrachloride	0.3408	0.0303
1,1-Dichloroethene	0.3408	0.0303
Trans-1,2-Dichloroethene	1.0704	0.1515
Tetrachloroethene	0.1704	0.0151
Trichloroethene	none detected	
Methylene Chloride	0.3408	0.0303
1,2,4-Trichlorobenzene	1.364	0.1212
Vinyl Chloride	3.408	0.303
Cadmium	1.70	0.1511
Chromium Trivalent	5.28	0.4693
Chromium Hexavalent	1.88	0.1671
Total	8.52	0.7573
Copper	0.28	0.0245
Lead	8.52	0.7573
Nickel	3.75	0.3333
Zinc	2.56	0.2276
Arsenic	8.52	0.7573
Mercury	0.34	0.0302
Selenium	1.70	0.1511
Iron	92.9	15.2
TSS	5270	607
TDS	2934	758
Acute Toxicity (LC50)-%eff	50	50
Chronic Toxicity (NOEC)-%eff	89	100
pH Standard Units	4 minimum - 7 maximum	

TECHNOLOGY BASED	average/maximum
Ethylbenzene	0.485/1.64
Toluene	0.394/1.219
1,1,1-Trichloroethane	0.318/0.819
1,2-Dichlorobenzene	1.170/2.470
1,3-Dichlorobenzene	0.470/0.667
1,4-Dichlorobenzene	0.227/0.425
bis(2-Ethylhexyl)Phthalate	1.560/4.230
Naphthalene	0.334/0.895
Nitrobenzene	0.409/1.030
Phenol	0.227/0.394
Petroleum Hydrocarbons-mg/l	10 /15

A minimum of 95% TOC removal is required when influent TOC >100 mg/l. When influent TOC <100 mg/l, a maximum TOC effluent limitation of 5.0 mg/l is required.

**Toms River discharge is the more stringent of the water quality based discharge criteria or the average technology based discharge.

TABLE 4A

PROPOSED DISCHARGE CRITERIA FOR TOMS RIVER (CONCENTRATION UNITS)**

TO BE CONSIDERED

(Revised December 9, 1988)

POLLUTANT	DISCHARGE TO THE TOMS RIVER (ug/l) (no diffuser)
Benzene	1
Chlorobenzene	4
Chloroform	0.19
1,2-Dichloroethane	2
Carbon Tetrachloride	2
*Ethylbenzene	32
*Toluene	26
1,1-Dichloroethene	2
Trans-1,2-Dichloroethene	10
Tetrachloroethene	1
Trichloroethene	1
*1,1,1-Trichloroethane	21
Methylene Chloride	2
*1,2-Dichlorobenzene	77
*1,3-Dichlorobenzene	31
*1,4-Dichlorobenzene	15
*bis(2-Ethylhexyl)Phthalate	103
*Naphthalene	22
*Nitrobenzene	27
*Phenol	15
1,2,4-Trichlorobenzene	8
Vinyl Chloride	2
Cadmium	10
Chromium	
Trivalent	31
Hexavalent	11
Total	50
Copper	1.65
Lead	50
Nickel	22
Zinc	15
Arsenic	50
Mercury	2
Selenium	10
Iron	1000
TSS mg/l	40
TDS mg/l	45@
Acute Toxicity (LC50) - % eff	≥50
Chronic Toxicity (NOEC) - % eff	≥100
pH Standard Units	4 - 7

* Pollutant criteria that are technology based.

**Toms River discharge is the more stringent of the water quality based discharge criteria without diffuser or the average technology based discharge.

@ or 1.33 times background where the discharger demonstrates the increase will not adversely affect the aquatic biota.

TABLE 5

CHEMICAL-SPECIFIC ARARs FOR GROUNDWATER PROTECTION

NEW JERSEY DRINKING WATER STANDARDS: JANUARY, 1989

CONTAMINANTS (mg/L unless otherwise noted)	TREATED WATER
Physical:	
Turbidity	1 TU (Nepthalometric Turbidity Unit)
Color	10 CU (Color Units)
Odor	3 TON (Threshold Odor Number)
Total Dissolved Solids	500
Microbiological:	
Total Coliform	1 per 100 ml
Inorganic Chemicals:	
Arsenic	0.05
Barium	1
Cadmium	0.01
Chloride	250
Chromium	0.05
Copper	1
Corrosivity	Within 1 of Optimum pH as determined by Langlier Index
Fluoride	2
Foaming Agents	0.5
Hardness (as $CaCO_3$)	250
Iron	0.3
Lead	0.05
Manganese	0.05
Mercury	0.002
Nitrate	10
pH Units	6.5 - 8.5
Selenium	0.01
Silver	0.05
Sodium	50
Sulfate	250
Zinc	5

TABLE 5 (continued)

CHEMICAL-SPECIFIC ARARs FOR GROUNDWATER PROTECTION

NEW JERSEY DRINKING WATER STANDARDS: JANUARY, 1989

CONTAMINANTS (mg/L unless otherwise noted)	TREATED WATER
Organic Chemicals:	
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	.1
2,4,5-TP (Silvex)	0.01
Trihalomethane (THM)	0.10
Radioactivity:	
Gross Alpha	15 pCi/L
Combined Radium (226 & 228)	5 pCi/L
Manmade: Beta	4 millirem/yr.
NJA-280 Compounds (ug/l):	
Benzene	1
Carbon Tetrachloride	2
Chlordane	0.5
Chlorobenzene	4
m-Dichlorobenzene	600
o-Dichlorobenzene	600
p-Dichlorobenzene	75*
1,2-Dichloroethane	2
1,1-Dichloroethylene	2
cis-Dichloroethylene	10
trans-1,2-Dichloroethylene	10
Methylene Chloride	2
PCBs	0.5
Tetrachloroethylene	1
Trichlorobenzenes	8
1,1,1-Trichloroethylene	26
Trichloroethylene	1

*The EPA established MCL will apply because NJDEP will not be reproposing an MCL for this contaminant in the near future.

TABLE 6

CHEMICAL-SPECIFIC ARARs FOR GROUNDWATER PROTECTION

GENERAL GUIDELINES FOR UNREGULATED VOCs

EPA Carcinogenicity Classification*	Recommended Guideline/Level
a,b	5 ppb (Single contaminant level not to exceed)
c,d,e	50 ppb (Single contaminant level not to exceed)
Total for all unregulated VOCs	50 ppb (Total for all VOCs not to exceed)

*Based on U.S. EPA 1986 as shown below

U.S. EPA CATEGORIZATION OF WEIGHT OF EVIDENCE FOR HUMAN CARCINOGENICITY

GROUP A: **HUMAN CARCINOGEN** - Sufficient evidence from human epidemiological studies.

GROUP B: **PROBABLE HUMAN CARCINOGEN** -

Group B1: Limited evidence from human epidemiological studies.

Group B2: Sufficient evidence from animal studies and inadequate or no data from human epidemiological studies.

GROUP C: **POSSIBLE HUMAN CARCINOGEN** - Limited evidence of carcinogenicity from animal studies in the absence of human data.

GROUP D: **NOT CLASSIFIABLE AS TO HUMAN CARCINOGENICITY** - Inadequate human and animal evidence for carcinogenicity or no data available.

GROUP E: **EVIDENCE OF NONCARCINOGENICITY FOR HUMANS** - No evidence for carcinogenicity in at least two adequate human epidemiological and animal studies.

TABLE 7

COMPONENT 1 - GROUNDWATER EXTRACTION ALTERNATIVES

Alternative GE-1	No further action with monitoring
Alternative GE-2	Groundwater extraction (groundwater monitoring, sealing of residential wells)
Alternative GE-3	Groundwater extraction with injection of clean water (groundwater monitoring, sealing of residential wells)

TABLE 8

COMPONENT 2 - GROUNDWATER DISCHARGE ALTERNATIVES

Alternative GD-1	Ocean discharge through the existing CIBA-GEIGY pipeline
Alternative GD-2A	Discharge to the Toms River by pipe
Alternative GD-2B	Discharge to the Toms River by seepage network
Alternative GD-3A	Discharge to Upper Sand Aquifer, 30% reinjection of treated groundwater
Alternative GD-3B	Discharge to Upper Sand Aquifer, 100% reinjection of treated groundwater
Alternative GD-3C	Discharge to Upper Sand Aquifer, 100% recharge of treated groundwater using reinjection wells and infiltration basins
Alternative GD-4	Discharge to Ocean County Utilities Authority

TABLE 9

COMPONENT 3 - GROUNDWATER TREATMENT ALTERNATIVES

Existing Wastewater Treatment Plant Operation:

Alternative GT-1A	CIBA-GEIGY wastewater treatment plant combined treatment of process wastewater and groundwater with discharge to the Atlantic Ocean
Alternative GT-1B	CIBA-GEIGY wastewater treatment plant separate treatment of process wastewater and groundwater with discharge to the Atlantic Ocean
Alternative GT-1C	CIBA-GEIGY wastewater treatment plant treatment of contaminated groundwater only with discharge to the Atlantic Ocean
Alternative GT-1D	CIBA-GEIGY wastewater treatment plant separate treatment of process wastewater and contaminated groundwater with discharge to the Toms River or upper sand aquifer
Alternative GT-1E	CIBA-GEIGY wastewater treatment plant treatment of contaminated groundwater only with discharge to the Toms River or upper sand aquifer
Alternative GT-1F	CIBA-GEIGY wastewater treatment plant treatment to nondetectable levels

Newly Constructed On-Site Wastewater Treatment Plant:

Alternative GT-2A	New physical/chemical treatment plant with discharge to the Atlantic Ocean
Alternative GT-2B	New biological treatment plant with discharge to the Atlantic Ocean
Alternative GT-2C	New biological treatment plant with discharge to the Toms River or upper sand aquifer
Alternative GT-2D	New biological treatment plant with treatment to nondetectable levels

Ocean County Utilities Authority (OCUA) Treatment Facility:

Alternative GT-3	OCUA wastewater treatment plant

In-Situ Bioreclamation System:

Alternative GT-4	In-situ bioreclamation system

TABLE 10A

COMPARISON OF PRESENT WORTH FOR COMPONENT ONE (GROUNDWATER EXTRACTION) REMEDIAL ALTERNATIVES[a]

ALTERNATIVE	DESCRIPTION	CAPITAL COST ($)	O & M COSTS ($/yr)	PRESENT WORTH VALUE ($)
GE-1	NO FURTHER ACTION WITH MONITORING	293,000	517,000	5,163,000
GE-2	GROUNDWATER EXTRACTION (GROUNDWATER MONITORING, SEALING OF RESIDENTIAL WELLS)	4,432,000 (7,950,000)[b]	592,000 (592,000)[b]	10,009,000 (13,526,000)[b]
GE-3	GROUNDWATER EXTRACTION WITH INJECTION OF CLEAN WATER, (GROUNDWATER MONITORING, SEALING OF RESIDENTIAL WELLS)	6,907,000	614,000	13,156,000

[a] Costs taken from "Final Report-CIBA-GEIGY Technical Enforcement Support Document, Groundwater Modelling Report," (CDM, April 1989).

[b] The cost to implement this alternative with additional wells to eliminate the stagnation zone.

TABLE 10B

COMPARISON OF PRESENT WORTH FOR COMPONENT TWO (TREATED GROUNDWATER DISCHARGE) REMEDIAL ALTERNATIVES[a]

ALTERNATIVE	DESCRIPTION	CAPITAL COST ($)	O & M COSTS ($/yr)	PRESENT WORTH VALUE ($)
GD-1[b]	OCEAN DISCHARGE THROUGH THE EXISTING CIBA-GEIGY PIPELINE	-	380,000	3,582,000
GD-2A	DISCHARGE TO TOMS RIVER BY PIPE	675,000	20,000	864,000
GD-2B	DISCHARGE TO TOMS RIVER BY SEEPAGE NETWORK	4,452,000	80,000	5,206,000
GD-3A	DISCHARGE TO UPPER SAND AQUIFER/30% REINJECTION OF TREATED GROUNDWATER	13,599,000	717,000	22,138,000
GD-3B	DISCHARGE TO UPPER SAND AQUIFER/100% REINJECTION OF TREATED GROUNDWATER	15,549,000	729,000	24,204,000
GD-3C	DISCHARGE TO UPPER SAND AQUIFER/100% RECHARGE OF TREATED GROUNDWATER USING REINJECTION WELLS AND INFILTRATION BASINS	12,692,000	729,000	20,024,000

[a] Costs taken from "Final Report-CIBA-GEIGY Plant, Groundwater Treatment Alternatives," (CDM, April 1989).

[b] Costs provided by CIBA-GEIGY

TABLE 10C

COMPARISON OF PRESENT WORTH FOR COMPONENT THREE (GROUNDWATER TREATMENT) REMEDIAL ALTERNATIVES[a]

ALTERNATIVE	DESCRIPTION	CAPITAL COST ($)	O & M COSTS ($/yr)	PRESENT WORTH VALUE ($)
GT-1A[b]	CIBA-GEIGY WASTEWATER TREATMENT PLANT (CGWWTP) COMBINED TREATMENT OF PROCESS WASTEWATER & GROUNDWATER WITH DISCHARGE TO OCEAN	20,534,000	4,072,000	58,921,000
GT-1B	CGWWTP SEPARATE TREATMENT OF PROCESS WASTEWATER AND GROUNDWATER WITH DISCHARGE TO OCEAN	25,522,000	4,072,000	63,909,000
GT-1C	CGWWTP TREATMENT OF CONTAMINATED GROUNDWATER ONLY WITH DISCHARGE TO OCEAN	20,534,000	4,072,000	58,921,000
GT-1D	CGWWTP SEPARATE TREATMENT OF PROCESS WASTEWATER & CONTAMINATED GROUNDWATER WITH DISCHARGE TO TOMS RIVER OR UPPER SAND AQUIFER	42,663,000	11,927,000	155,099,000

[a] Costs taken from "Final Report-CIBA-GEIGY Plant, Groundwater Treatment Alternatives, Toms River, New Jersey," (CDM, April 1989).

[b] Costs estimated from "CIBA-GEIGY Feasibility Study," (NUS, April 1989) and "Final Report-CIBA-GEIGY Plant, Groundwater Treatment Alternatives, Toms River, New Jersey," (CDM, April 1989).

TABLE 10C (continued)[a]

ALTERNATIVE	DESCRIPTION	CAPITAL COST ($)	O & M COSTS ($/yr)	PRESENT WORTH VALUE ($)
GT-1E	CGWWTP TREATMENT OF CONTAMINATED GROUNDWATER ONLY WITH DISCHARGE TO TOMS RIVER OR UPPER SAND AQUIFER	37,679,000	11,927,000	150,115,000
GT-1F	CGWWTP TREATMENT TO NONDETECTABLE LEVELS	42,269,000	12,291,000	158,136,000
GT-2A	NEW PHYSICAL/CHEMICAL TREATMENT PLANT WITH DISCHARGE TO OCEAN	32,994,000	3,544,000	66,403,000
GT-2B	NEW BIOLOGICAL TREATMENT PLANT WITH DISCHARGE TO OCEAN	36,281,000	3,750,000	71,632,000
GT-2C	NEW BIOLOGICAL TREATMENT PLANT WITH DISCHARGE TO TOMS RIVER OR UPPER SAND AQUIFER	56,869,000	11,719,000	167,344,000
GT-2D	NEW BIOLOGICAL TREATMENT PLANT WITH TREATMENT TO NONDETECTABLE LEVELS	64,760,000	12,470,000	182,315,000

[a] Costs taken from "Final Report-CIBA-GEIGY Plant, Groundwater Treatment Alternatives, Toms River, New Jersey," (CDM, April 1989).

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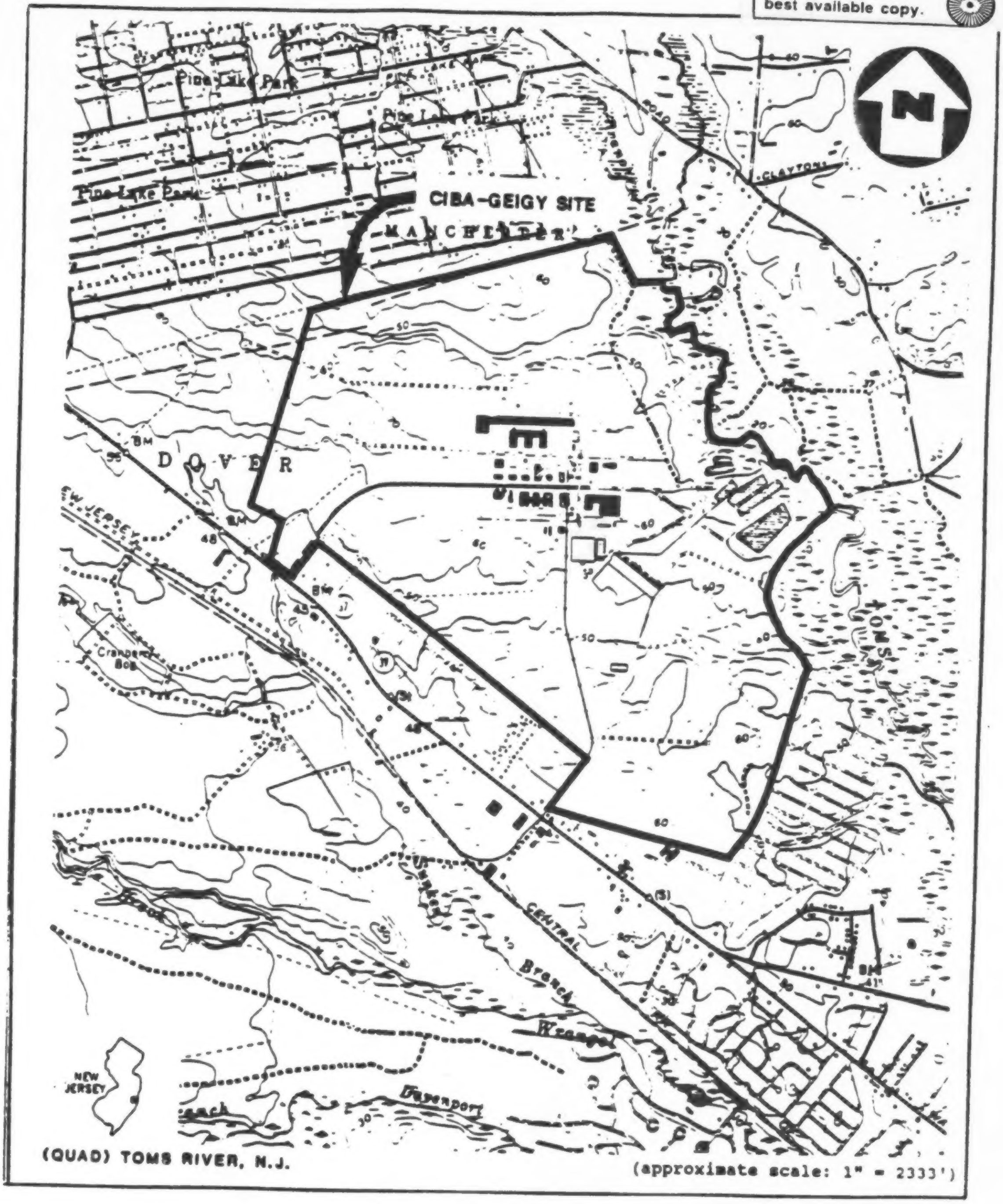
CIBA-GEIGY SITE
MANCHESTER
DOVER
Pine Lake Park
CLAYTON
N
NEW JERSEY
Cranberry Bog
CENTRAL
Branch
Wrangel
Davenport
TOMS
(QUAD) TOMS RIVER, N.J.
(approximate scale: 1" = 2333')

FIGURE 1

SITE LOCATION MAP

CIBA-GEIGY SITE, DOVER TOWNSHIP, NEW JERSEY

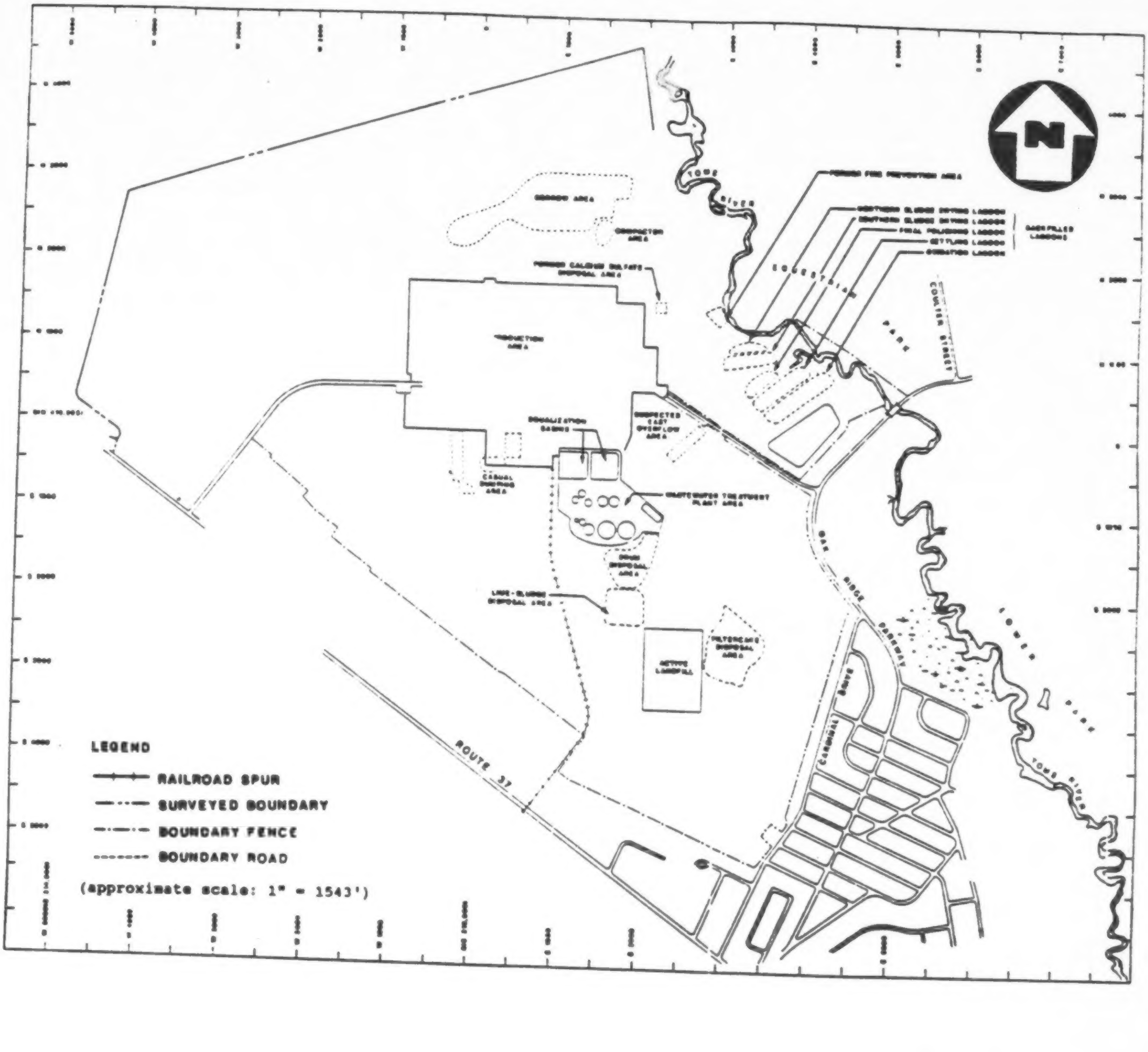
N
BORROW AREA
COMPACTOR AREA
TOMS RIVER
FORMER FIRE PREVENTION AREA
NORTHERN SLUDGE DRYING LAGOON
SOUTHERN SLUDGE DRYING LAGOON
FINAL POLISHING LAGOON
SETTLING LAGOON
OXIDATION LAGOON
BACKFILLED LAGOONS
FORMER CALCIUM SULFATE DISPOSAL AREA
EQUESTRIAN PARK
COULTER STREET
PRODUCTION AREA
EQUALIZATION BASINS
SUSPECTED EAST OVERFLOW AREA
CASUAL DUMPING AREA
WASTEWATER TREATMENT PLANT AREA
DRUM DISPOSAL AREA
LIME-SLUDGE DISPOSAL AREA
ACTIVE LANDFILL
FILTERCAKE DISPOSAL AREA
OAK RIDGE PARKWAY
CARDINAL DRIVE
LOWER PARK
TOMS RIVER
ROUTE 37
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
(approximate scale: 1" = 1543')

FIGURE 2

CIBA-GEIGY SITE PLAN

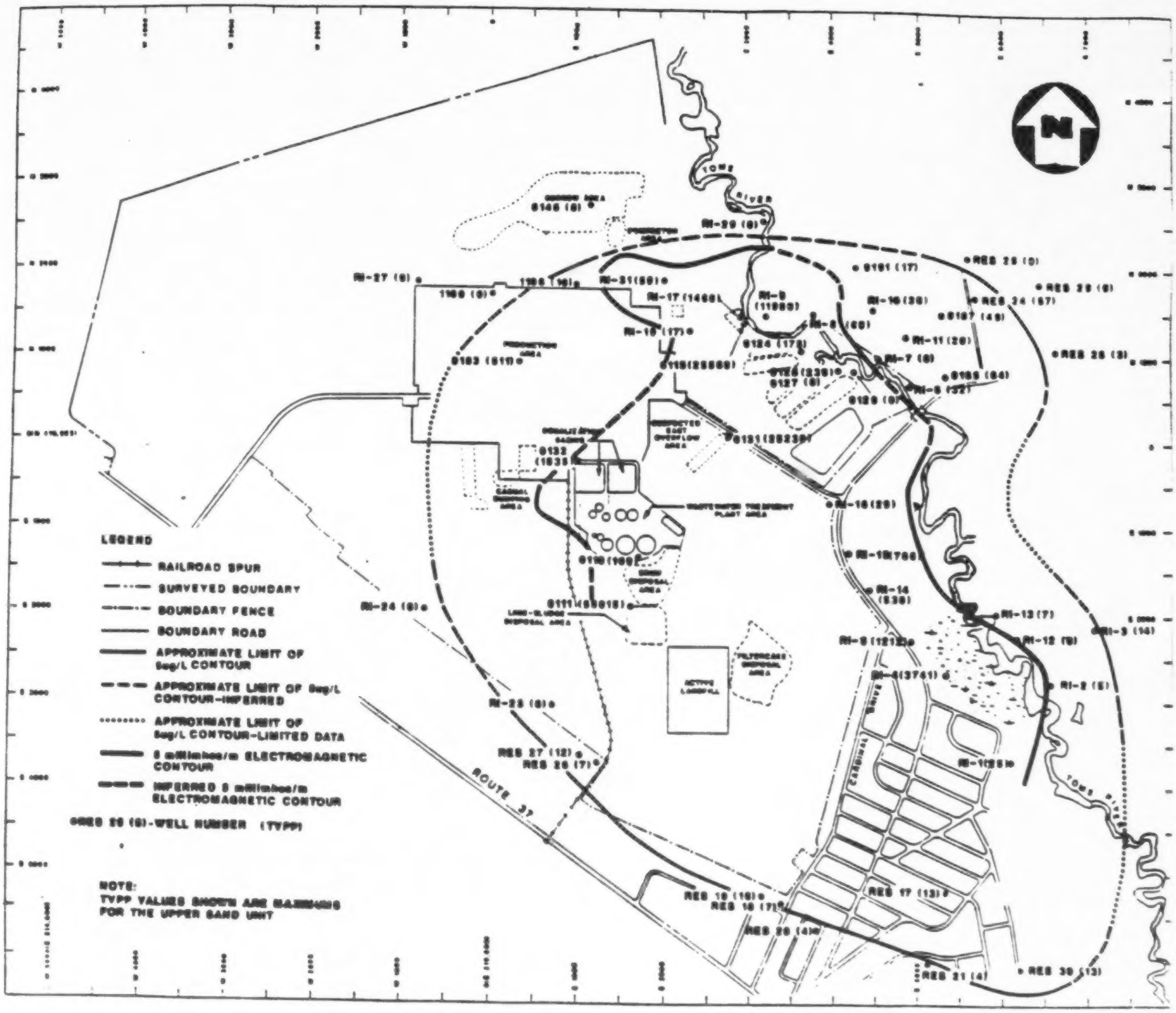
TOMS RIVER
RI-29 (0)
RI-27 (0)
1160 (0)
1156 (16)
RI-31 (50)
RI-17 (1460)
RI-9 (11090)
RI-15 (17)
PRODUCTION AREA
0163 (511)
0146 (0)
0124 (173)
0115 (25800)
0126 (230)
0127 (0)
0191 (17)
RI-10 (30)
0187 (49)
RI-11 (20)
RI-7 (0)
0185 (84)
RI-6 (32)
0128 (0)
RES 25 (0)
RES 23 (0)
RES 24 (57)
RES 26 (3)
0132 (1633)
0131 (25230)
WASTEWATER TREATMENT PLANT AREA
RI-16 (20)
RI-15 (766)
RI-14 (538)
0110 (109)
0111 (55015)
LIME-SLUDGE DISPOSAL AREA
RI-24 (0)
ACTIVE LANDFILL
FILTERCAKE DISPOSAL AREA
RI-13 (7)
RI-12 (9)
RI-3 (14)
RI-8 (1212)
RI-4 (3741)
RI-2 (5)
RI-23 (0)
RES 27 (12)
RES 28 (71)
RI-1 (25)
ROUTE 37
CARDINAL DRIVE
TOMS RIVER
RES 19 (16)
RES 18 (71)
RES 17 (13)
RES 20 (4)
RES 21 (4)
RES 30 (13)
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
APPROXIMATE LIMIT OF 5ug/L CONTOUR
APPROXIMATE LIMIT OF 5ug/L CONTOUR-INFERRED
APPROXIMATE LIMIT OF 5ug/L CONTOUR-LIMITED DATA
5 millimhos/m ELECTROMAGNETIC CONTOUR
INFERRED 5 millimhos/m ELECTROMAGNETIC CONTOUR
RES 26 (0)-WELL NUMBER (TVPP)
NOTE:
TVPP VALUES SHOWN ARE MAXIMUMS FOR THE UPPER SAND UNIT

FIGURE 3

APPROXIMATE LATERAL EXTENT TOTAL VOLATILE PRIORITY POLLUTANTS CONTAMINATION >5 ug/L AND ELECTROMAGNETIC CONDUCTIVITY CONTOURS >5 MILLIMHOS/M

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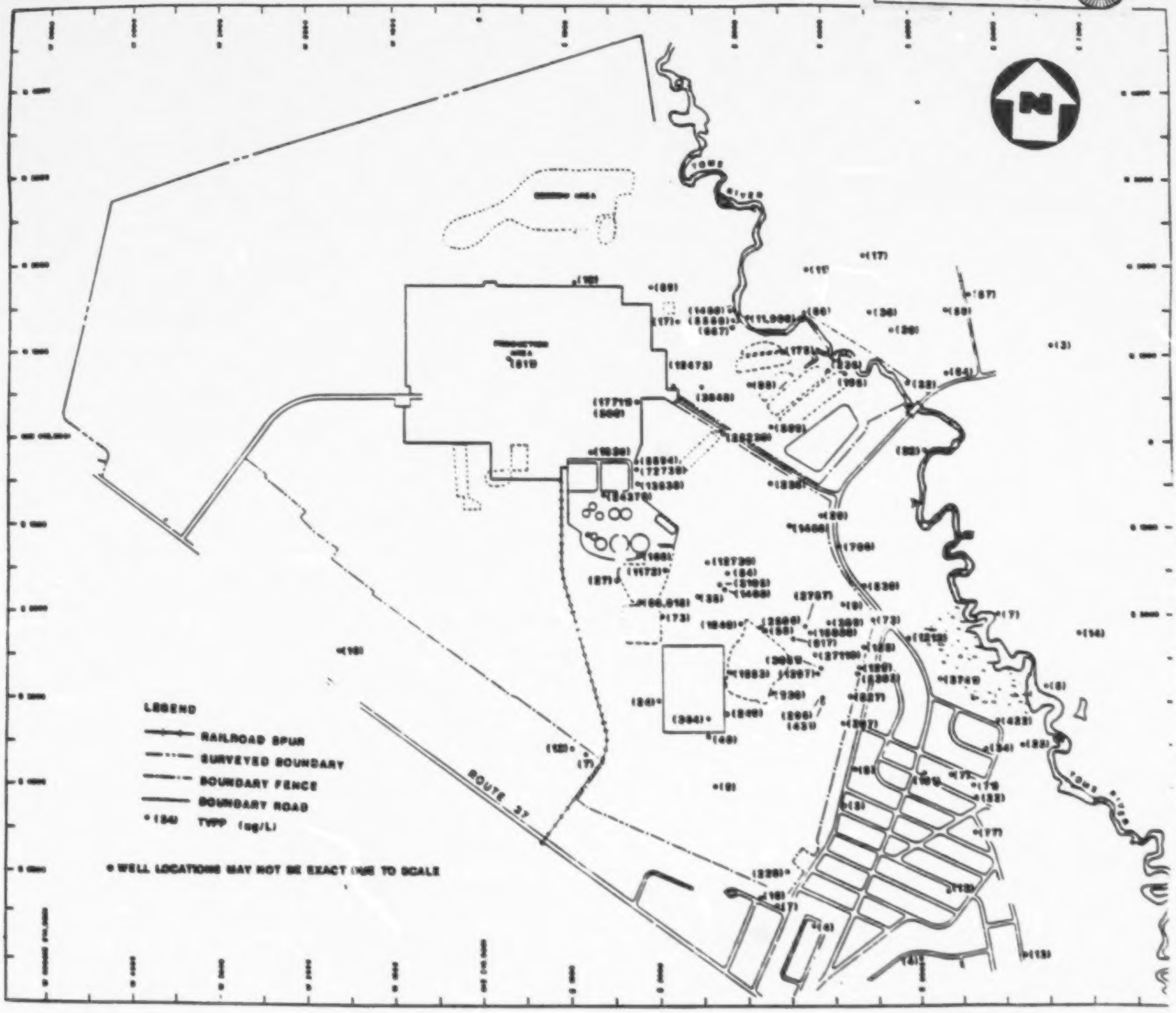
TOMS RIVER
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
• (34) TVPP (ug/L)
• WELL LOCATIONS MAY NOT BE EXACT DUE TO SCALE
ROUTE 37
N

FIGURE 4

MAXIMUM DETECTED TOTAL VOLATILE PRIORITY POLLUTANTS (TVPP)

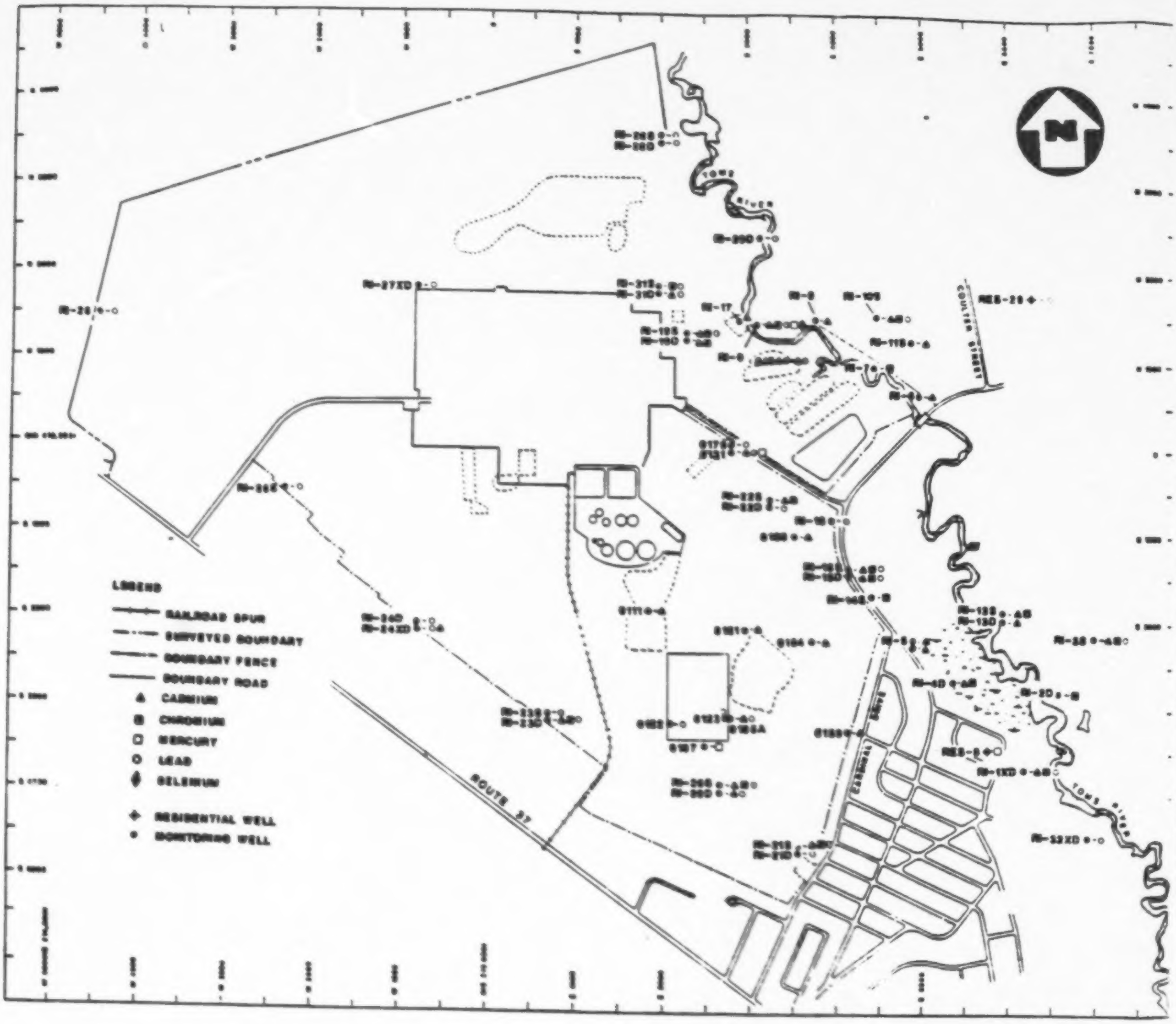
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
▲ CADMIUM
■ CHROMIUM
□ MERCURY
○ LEAD
♦ SELENIUM
◆ RESIDENTIAL WELL
• MONITORING WELL
TOMS RIVER
ROUTE 37
COULTER STREET
CARDINAL DRIVE
N

FIGURE 5

WELLS WITH INORGANIC CONTAMINANT CONCENTRATIONS ABOVE MAXIMUM CONTAMINATION LIMITS (MCL)

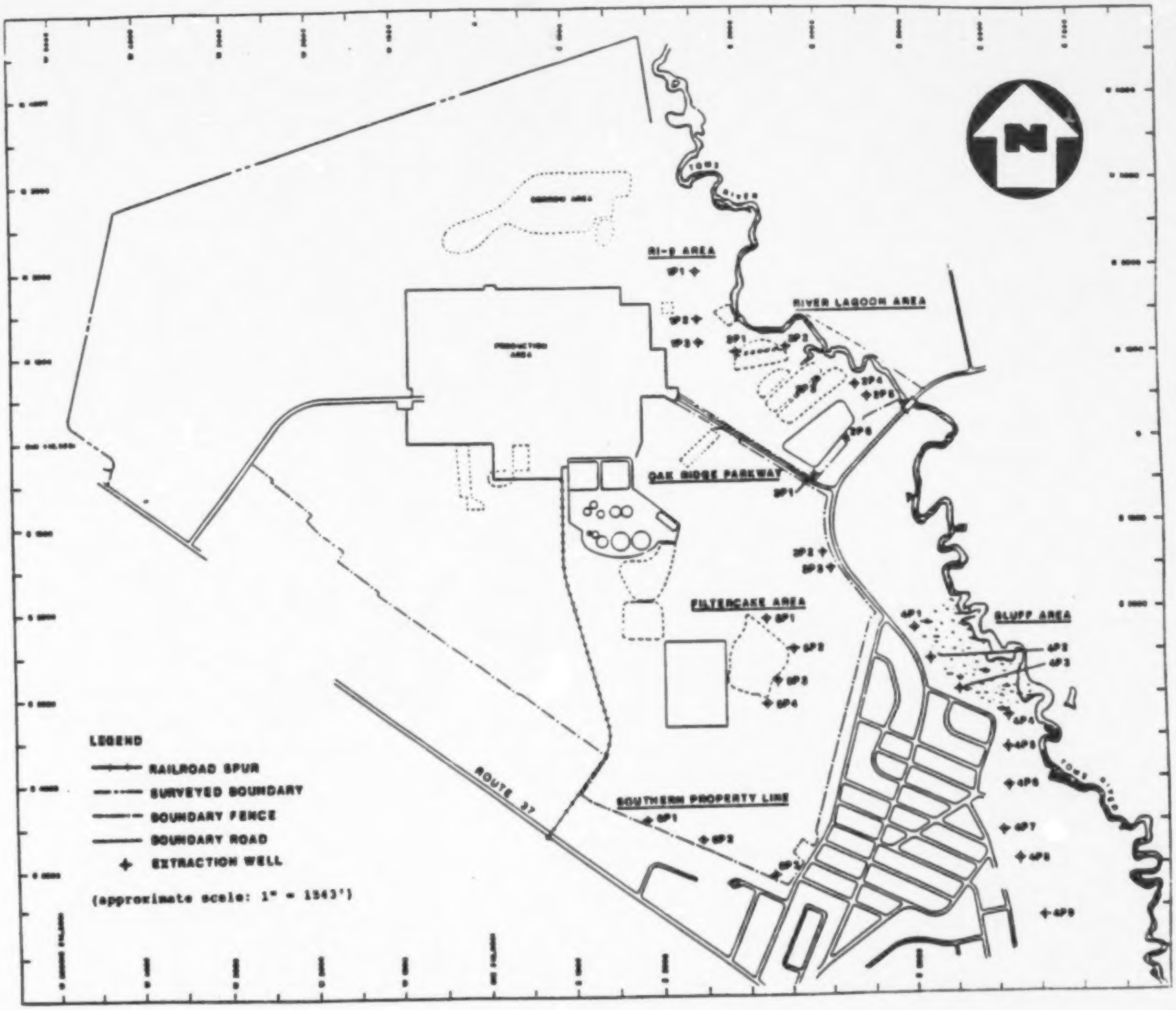
N
TOMS RIVER
PRODUCTION AREA
RI-9 AREA
RIVER LAGOON AREA
OAK RIDGE PARKWAY
FILTERCAKE AREA
BLUFF AREA
SOUTHERN PROPERTY LINE
ROUTE 37
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
EXTRACTION WELL
(approximate scale: 1" = 1543')

FIGURE 6

COMPONENT 1 - REMEDIAL ALTERNATIVE GE-2

INSTALLATION OF GROUNDWATER EXTRACTION WELLS

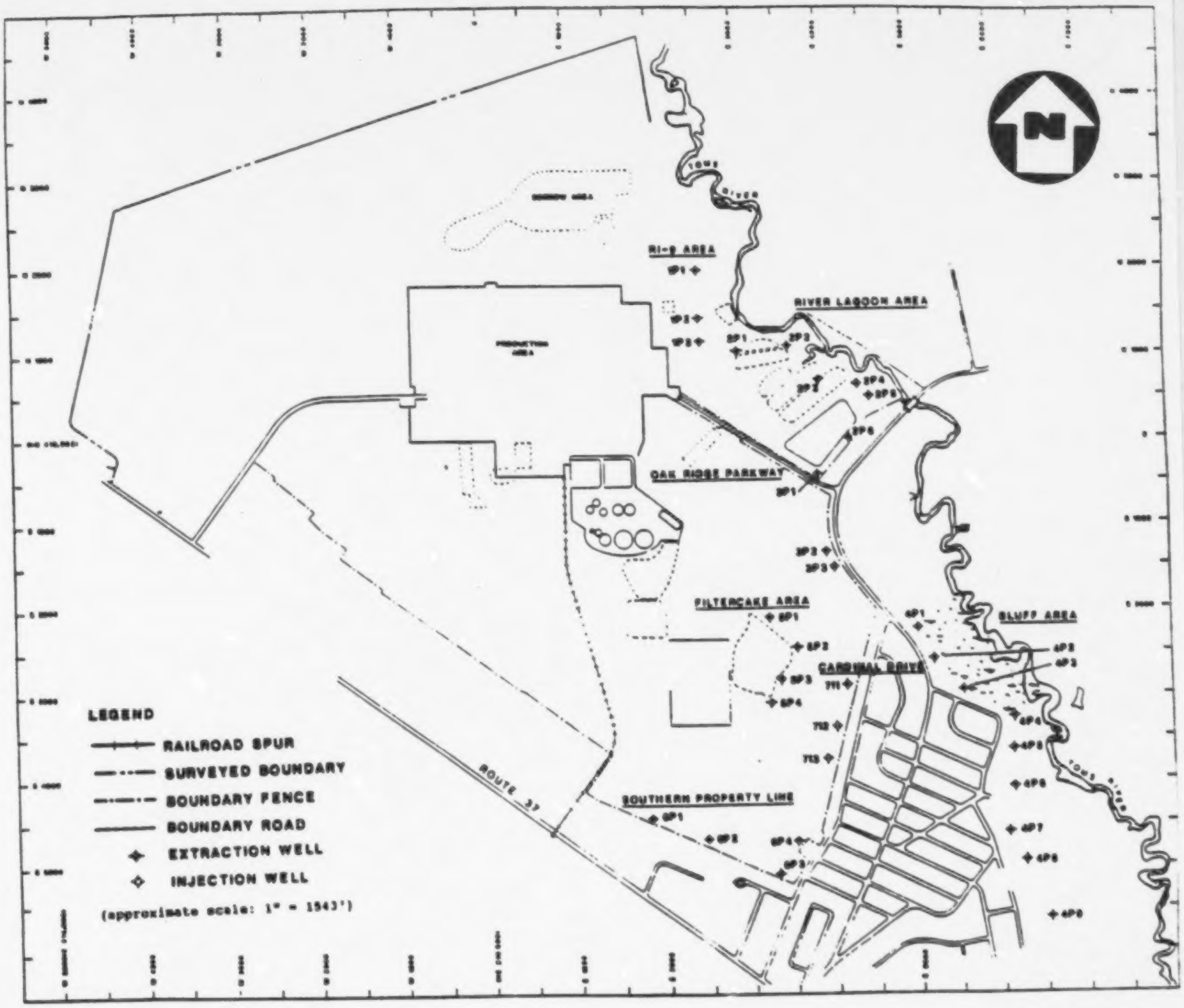
TOMS RIVER
RI-9 AREA
PRODUCTION AREA
RIVER LAGOON AREA
OAK RIDGE PARKWAY
FILTERCAKE AREA
BLUFF AREA
CARDINAL DRIVE
711
712
713
SOUTHERN PROPERTY LINE
ROUTE 37
TOMS RIVER
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
EXTRACTION WELL
INJECTION WELL
(approximate scale: 1" = 1543')

FIGURE 7

COMPONENT 1 - REMEDIAL ALTERNATIVE GE-3

INSTALLATION OF A GROUNDWATER EXTRACTION SYSTEM
AND PARTIAL INJECTION OF CLEAN WATER

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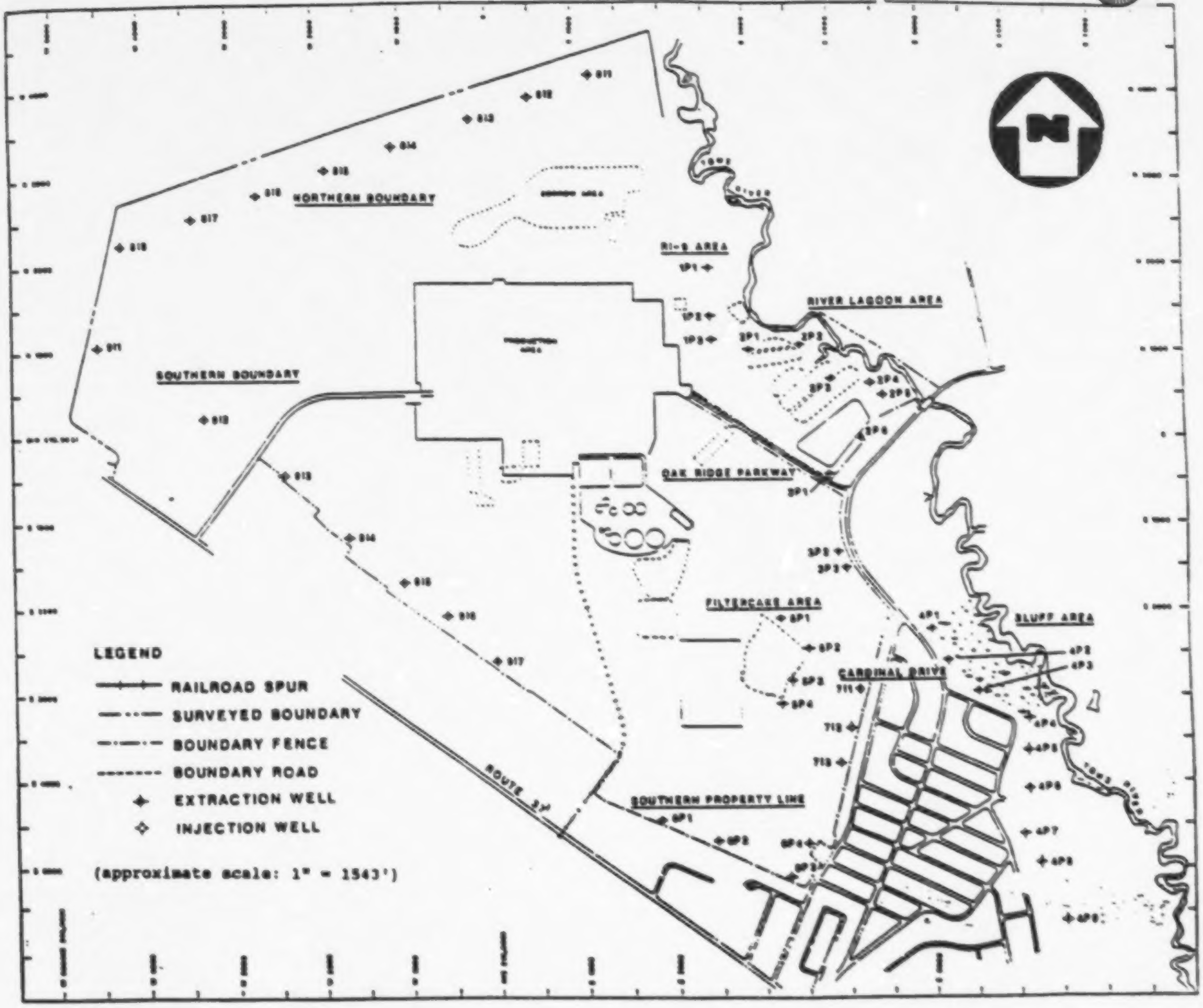

NORTHERN BOUNDARY
SOUTHERN BOUNDARY
RI-5 AREA
RIVER LAGOON AREA
OAK RIDGE PARKWAY
FILTERCAKE AREA
BLUFF AREA
CARDINAL DRIVE
SOUTHERN PROPERTY LINE
ROUTE 37
TOMS RIVER
1P1
1P2
1P3
2P1
2P2
2P3
2P4
2P5
2P6
3P1
3P2
3P3
4P1
4P2
4P3
4P4
4P5
4P6
4P7
4P8
4P9
5P1
5P2
5P3
5P4
6P1
6P2
711
712
713
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
EXTRACTION WELL
INJECTION WELL
(approximate scale: 1" = 1543')

FIGURE 8

COMPONENT 2 - REMEDIAL ALTERNATIVE GD-3B

DISCHARGE TO UPPER SAND AQUIFER
100% REINJECTION OF TREATED GROUNDWATER
THROUGH REINJECTION WELLS

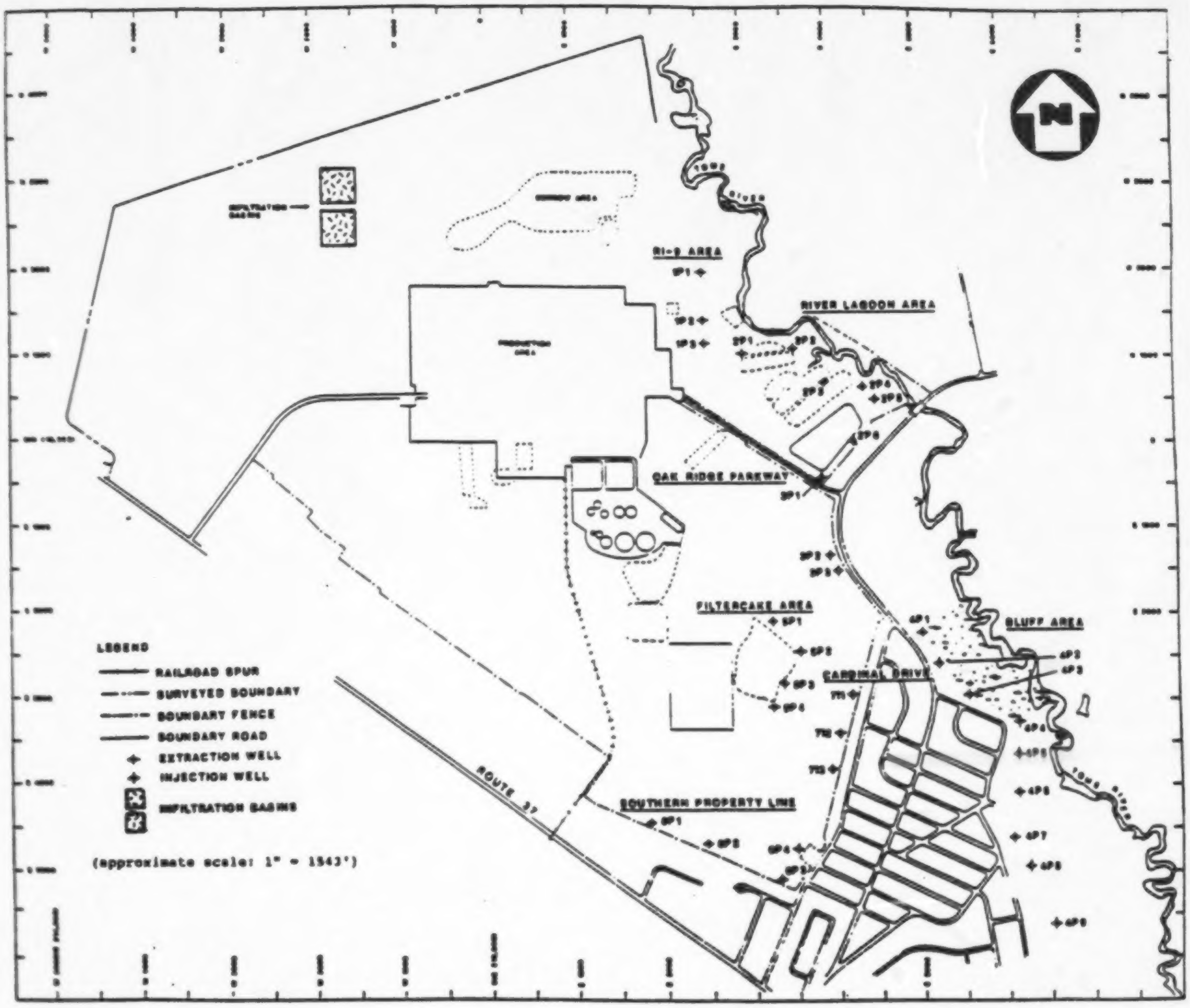

INFILTRATION BASINS
BORROW AREA
TOMS RIVER
RI-9 AREA
1P1
1P2
1P3
PRODUCTION AREA
RIVER LAGOON AREA
2P1
2P2
2P3
2P4
2P5
2P6
OAK RIDGE PARKWAY
3P1
3P2
3P3
FILTERCAKE AREA
5P1
5P2
5P3
5P4
BLUFF AREA
4P1
4P2
4P3
4P4
4P5
4P6
4P7
4P8
4P9
CARDINAL DRIVE
7P1
7P2
7P3
ROUTE 37
SOUTHERN PROPERTY LINE
6P1
6P2
6P4
6P5
LEGEND
RAILROAD SPUR
SURVEYED BOUNDARY
BOUNDARY FENCE
BOUNDARY ROAD
EXTRACTION WELL
INJECTION WELL
INFILTRATION BASINS
(approximate scale: 1" = 1543')

FIGURE 9

COMPONENT 2 - REMEDIAL ALTERNATIVE GD-3C

DISCHARGE TO UPPER SAND AQUIFER

100% RECHARGE OF TREATED GROUNDWATER

THROUGH REINJECTION WELLS AND INFILTRATION BASINS

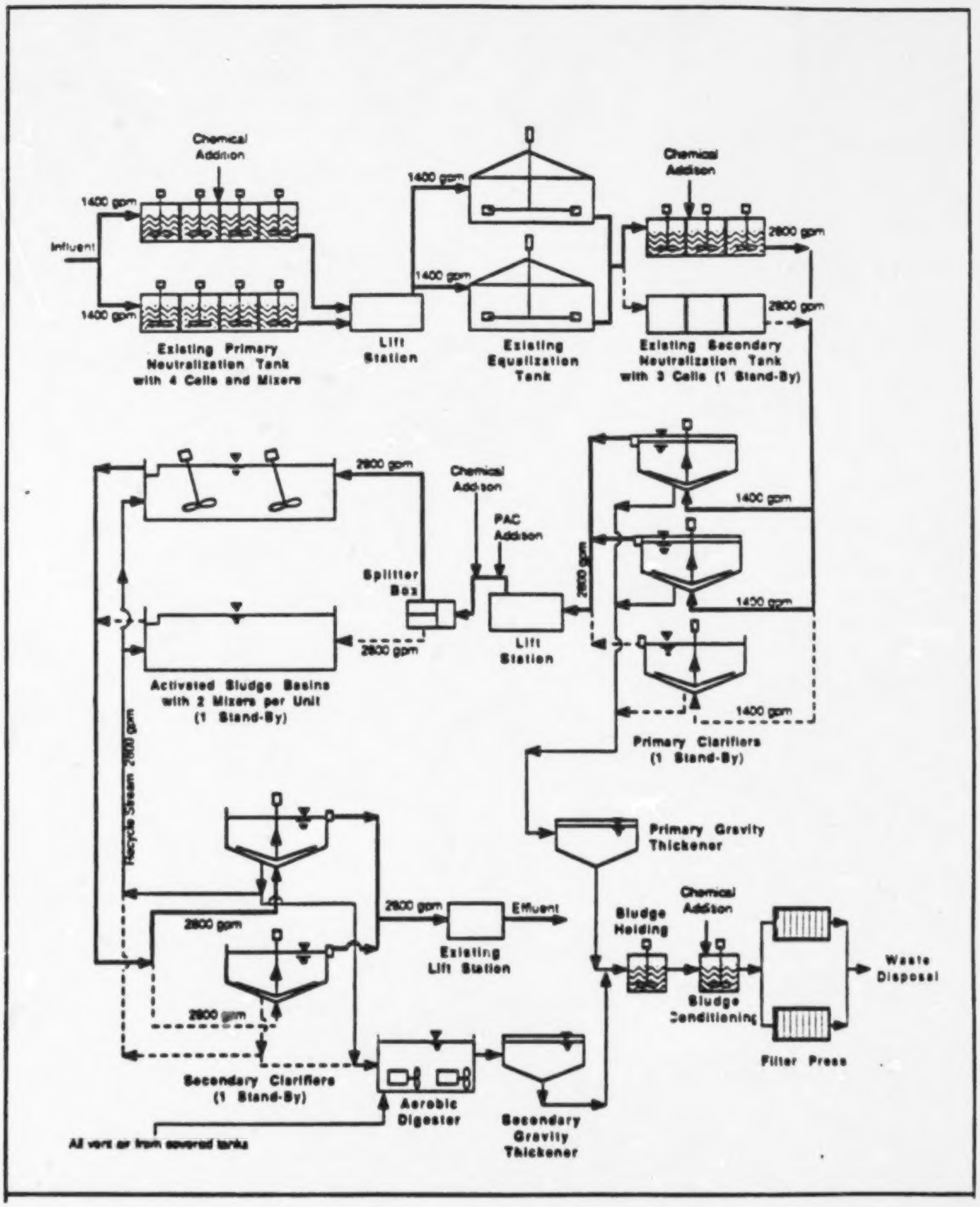

Chemical Addition
1400 gpm
Influent
1400 gpm
Existing Primary Neutralization Tank with 4 Cells and Mixers
Lift Station
1400 gpm
1400 gpm
Existing Equalization Tank
Chemical Addition
2800 gpm
2800 gpm
Existing Secondary Neutralization Tank with 3 Cells (1 Stand-By)
2800 gpm
Chemical Addition
PAC Addition
Splitter Box
2800 gpm
2800 gpm
Lift Station
1400 gpm
1400 gpm
1400 gpm
Activated Sludge Basins with 2 Mixers per Unit (1 Stand-By)
Primary Clarifiers (1 Stand-By)
Recycle Steam 2800 gpm
Primary Gravity Thickener
2800 gpm
2800 gpm
Effluent
Existing Lift Station
2800 gpm
Sludge Holding
Chemical Addition
Sludge Conditioning
Waste Disposal
Filter Press
Secondary Clarifiers (1 Stand-By)
Aerobic Digester
Secondary Gravity Thickener
All vent air from covered tanks

FIGURE 10

SCHEMATIC OF EXISTING CIBA-GEIGY WASTEWATER TREATMENT PLANT

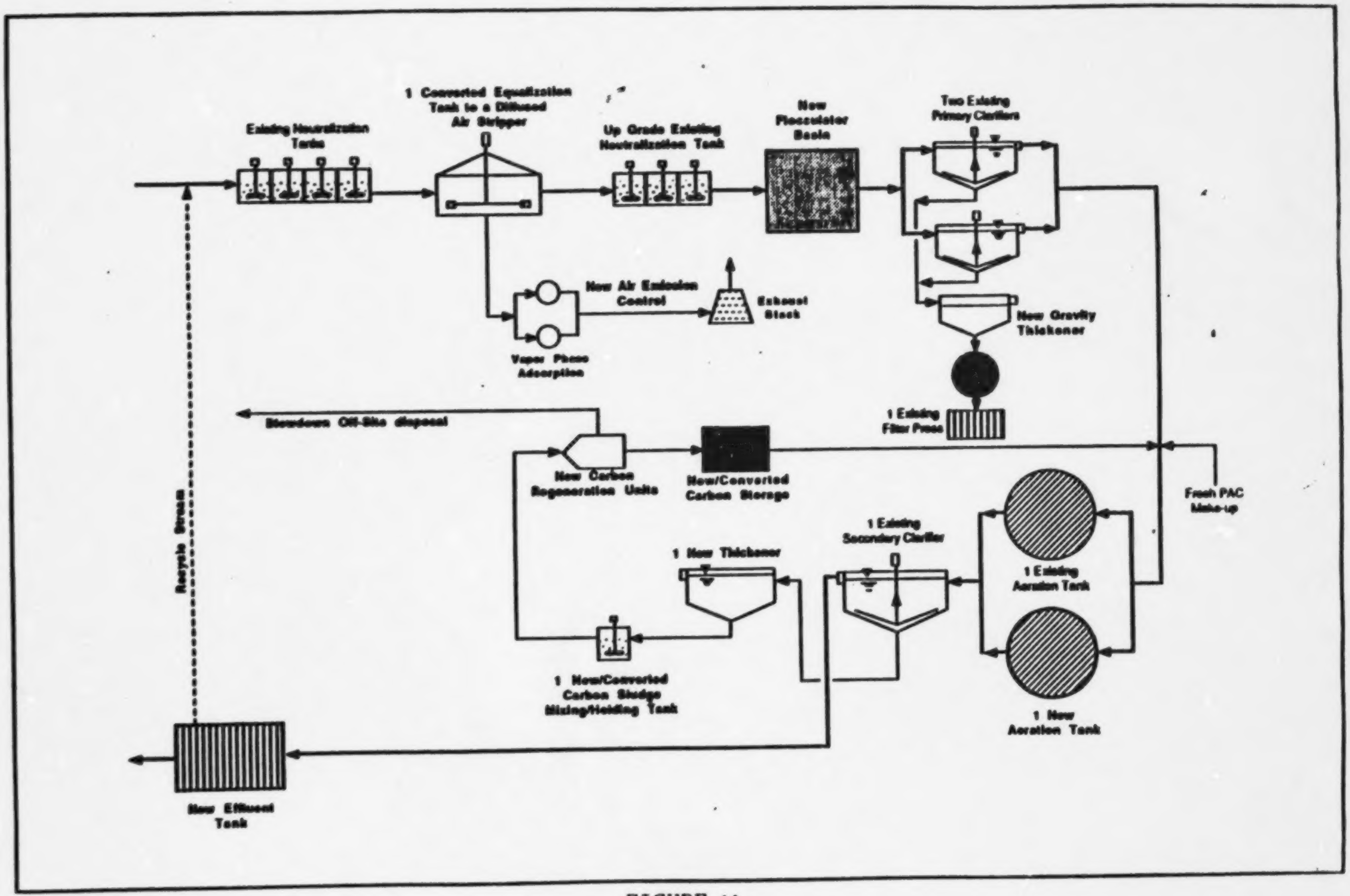

Existing Neutralization Tanks
1 Converted Equalization Tank to a Diffused Air Stripper
Up Grade Existing Neutralization Tank
New Flocculator Basin
Two Existing Primary Clarifiers
New Air Emission Control
Exhaust Stack
Vapor Phase Adsorption
New Gravity Thickener
1 Existing Filter Press
Blowdown Off-Site disposal
New Carbon Regeneration Units
New/Converted Carbon Storage
Fresh PAC Make-up
Recycle Stream
1 Existing Secondary Clarifier
1 Existing Aeration Tank
1 New Aeration Tank
1 New Thickener
1 New/Converted Carbon Sludge Mixing/Holding Tank
New Effluent Tank

FIGURE 11

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-1B

CIBA-GEIGY WASTEWATER TREATMENT PLANT SEPARATE TREATMENT OF PROCESS WASTEWATER AND GROUNDWATER WITH DISCHARGE TO THE ATLANTIC OCEAN

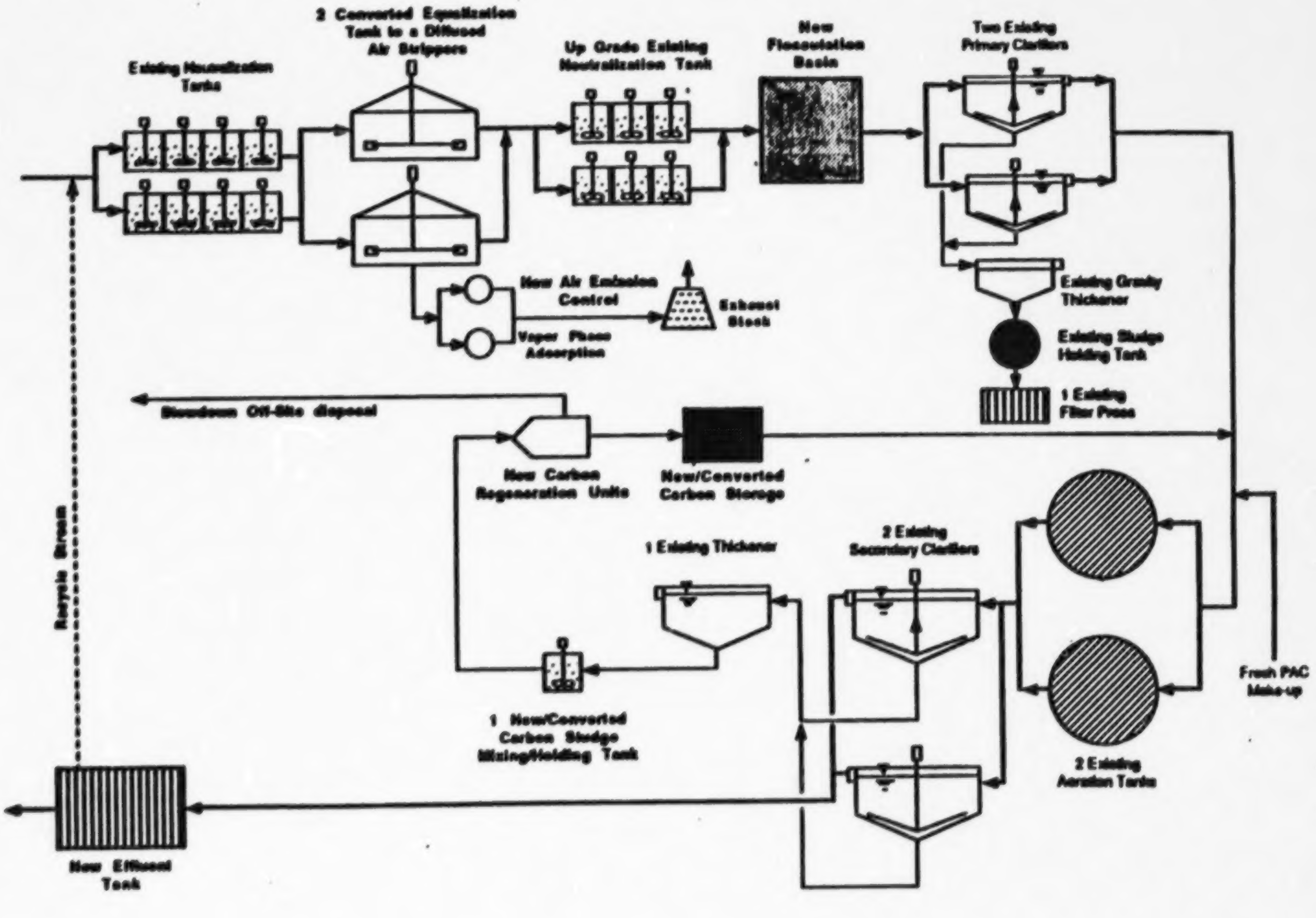

Existing Neutralization Tanks
2 Converted Equalization Tank to a Diffused Air Strippers
Up Grade Existing Neutralization Tank
New Flocculation Basin
Two Existing Primary Clarifiers
Existing Gravity Thickener
Existing Sludge Holding Tank
1 Existing Filter Press
New Air Emission Control
Vapor Phase Adsorption
Exhaust Stack
Blowdown Off-Site disposal
New Carbon Regeneration Units
New/Converted Carbon Storage
Recycle Stream
1 Existing Thickener
2 Existing Secondary Clarifiers
2 Existing Aeration Tanks
Fresh PAC Make-up
1 New/Converted Carbon Sludge Mixing/Holding Tank
New Effluent Tank

FIGURE 12

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-1C

CIBA-GEIGY WASTEWATER TREATMENT PLANT TREATMENT OF CONTAMINATED GROUNDWATER ONLY WITH DISCHARGE TO THE ATLANTIC OCEAN

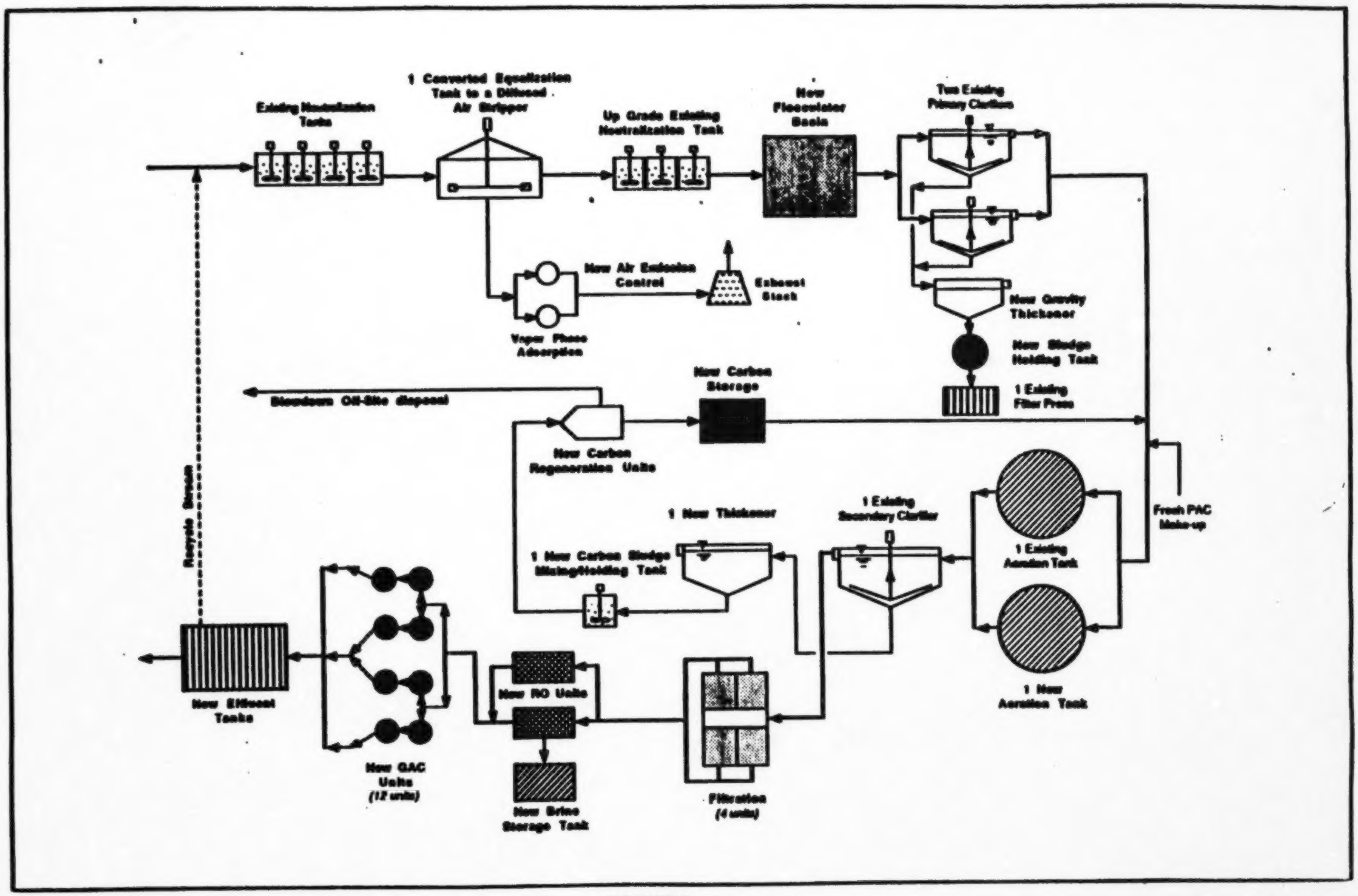

Existing Neutralization Tanks
1 Converted Equalization Tank to a Diffused Air Stripper
Up Grade Existing Neutralization Tank
New Flocculator Basin
Two Existing Primary Clarifiers
New Air Emission Control
Exhaust Stack
Vapor Phase Adsorption
New Gravity Thickener
New Sludge Holding Tank
1 Existing Filter Press
New Carbon Storage
Blowdown Off-Site disposal
New Carbon Regeneration Units
Recycle Stream
1 New Thickener
1 Existing Secondary Clarifier
Fresh PAC Make-up
1 Existing Aeration Tank
1 New Carbon Sludge Mixing/Holding Tank
1 New Aeration Tank
New Effluent Tanks
New RO Units
New GAC Units
(12 units)
New Brine Storage Tank
Filtration
(4 units)

FIGURE 13

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-1D

CIBA-GEIGY WASTEWATER TREATMENT PLANT SEPARATE TREATMENT OF PROCESS WASTEWATER AND CONTAMINATED GROUNDWATER WITH DISCHARGE TO THE TOMS RIVER OR UPPER SAND AQUIFER

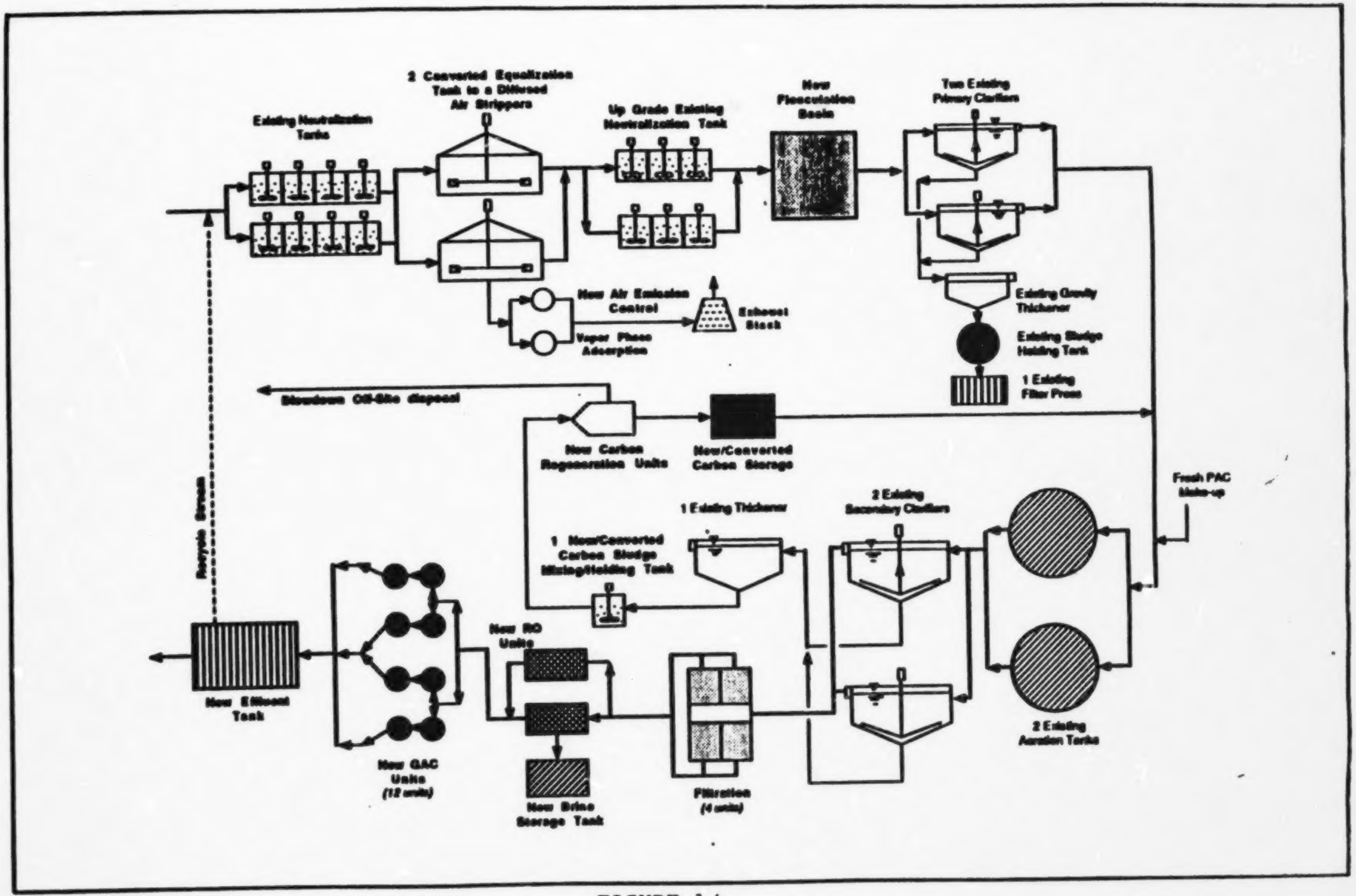

Existing Neutralization Tanks
2 Converted Equalization Tank to a Diffused Air Strippers
Up Grade Existing Neutralization Tank
New Flocculation Basin
Two Existing Primary Clarifiers
Existing Gravity Thickener
Existing Sludge Holding Tank
1 Existing Filter Press
New Air Emission Control
Vapor Phase Adsorption
Exhaust Stack
Blowdown Off-Site disposal
New Carbon Regeneration Units
New/Converted Carbon Storage
Fresh PAC Make-up
Recycle Stream
1 Existing Thickener
2 Existing Secondary Clarifiers
1 New/Converted Carbon Sludge Mixing/Holding Tank
New RO Units
New Effluent Tank
New GAC Units (12 units)
New Brine Storage Tank
Filtration (4 units)
2 Existing Aeration Tanks

FIGURE 14

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-1E

CIBA-GEIGY WASTEWATER TREATMENT PLANT TREATMENT OF CONTAMINATED GROUNDWATER ONLY WITH DISCHARGE TO THE TOMS RIVER OR UPPER SAND AQUIFER

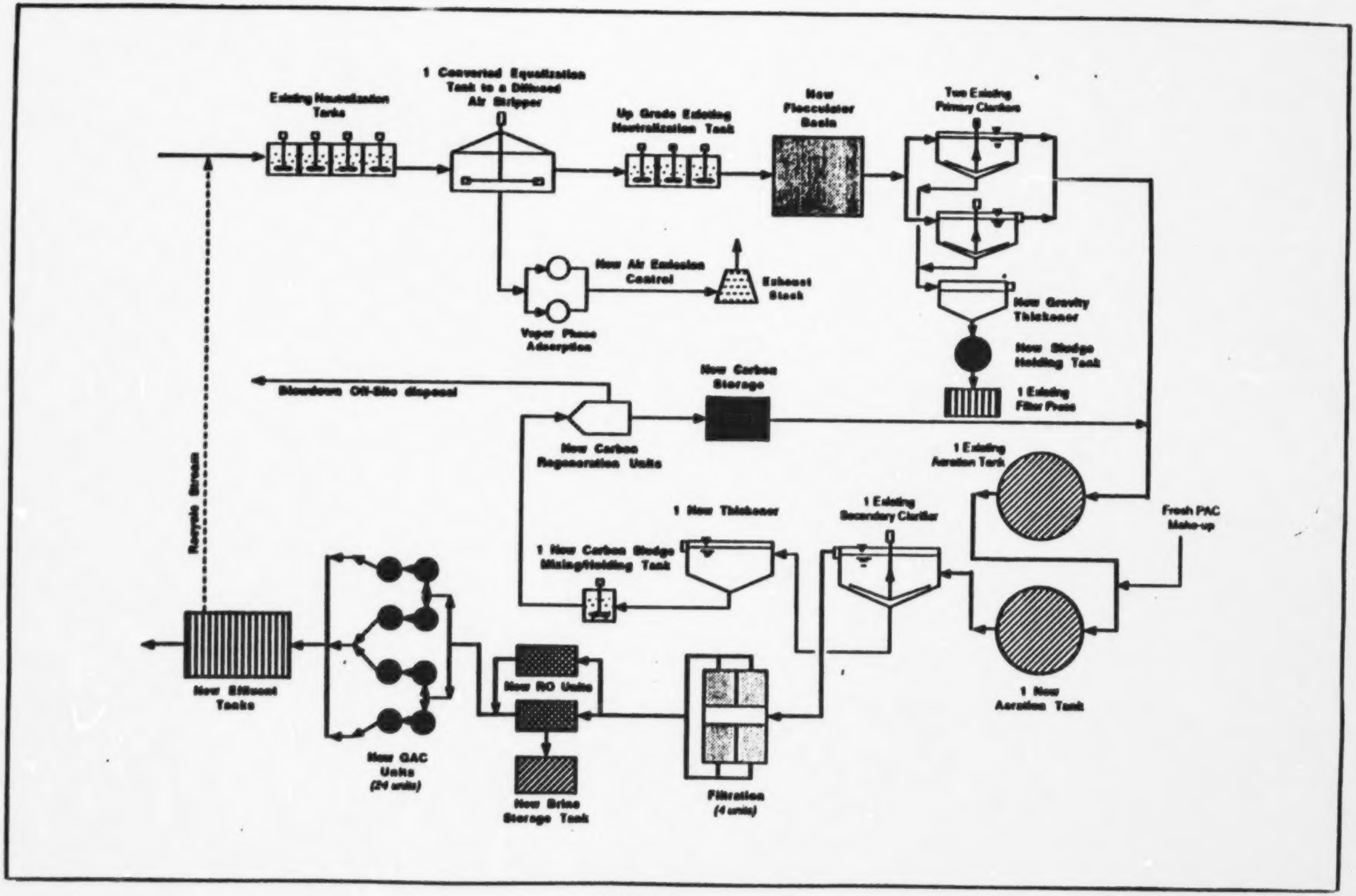

Existing Neutralization Tanks
1 Converted Equalization Tank to a Diffused Air Stripper
Up Grade Existing Neutralization Tank
New Flocculator Basin
Two Existing Primary Clarifiers
New Air Emission Control
Exhaust Stack
Vapor Phase Adsorption
New Gravity Thickener
New Sludge Holding Tank
1 Existing Filter Press
Blowdown Off-Site disposal
New Carbon Storage
New Carbon Regeneration Units
1 Existing Aeration Tank
Fresh PAC Make-up
1 New Thickener
1 Existing Secondary Clarifier
1 New Carbon Sludge Mixing/Holding Tank
Recycle Stream
New Effluent Tanks
New GAC Units (24 units)
New RO Units
New Brine Storage Tank
Filtration (4 units)
1 New Aeration Tank

FIGURE 15

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-1F

CIBA-GEIGY WASTEWATER TREATMENT PLANT SEPARATE TREATMENT TO NON-DETECTABLE LEVELS

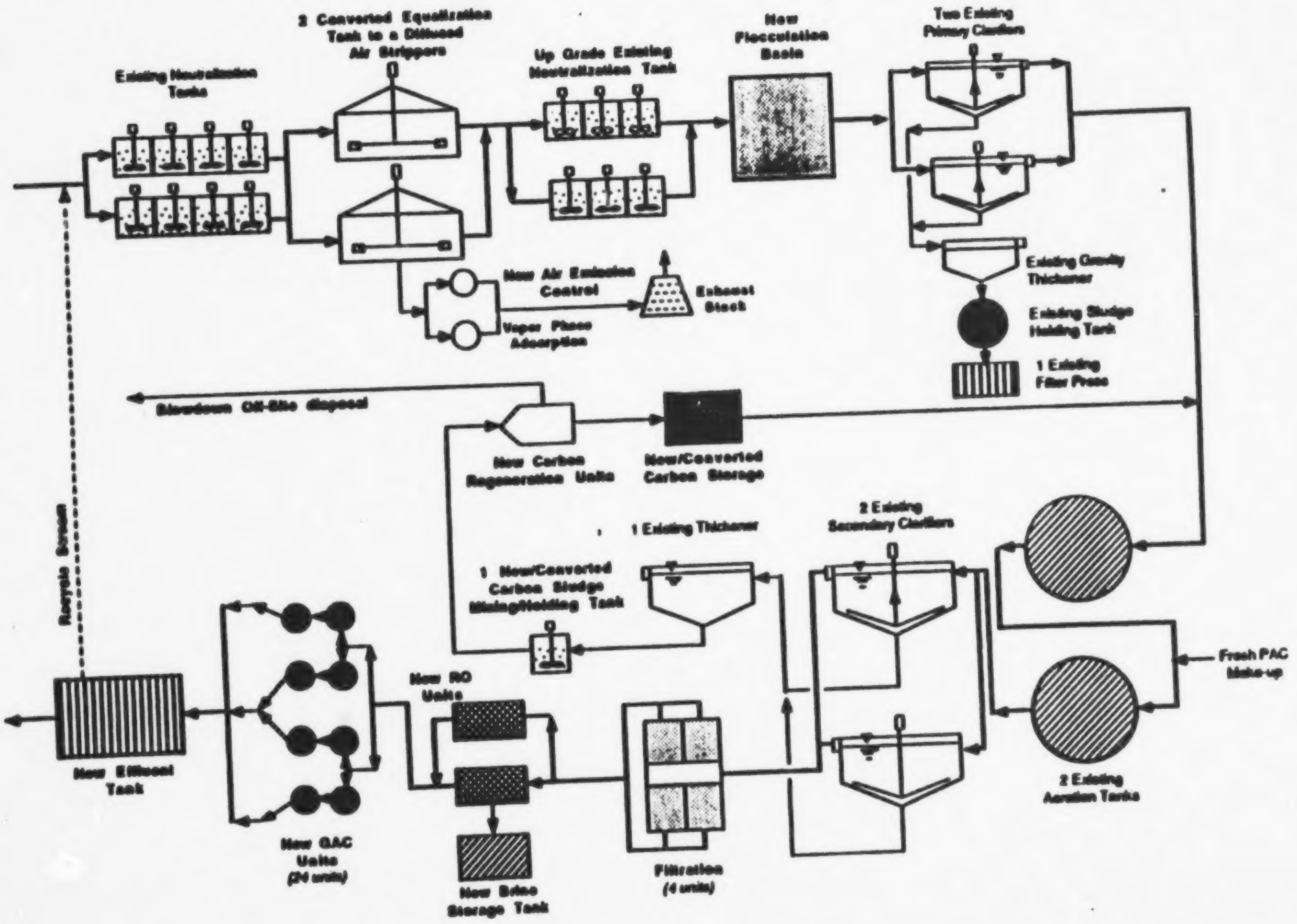

Existing Neutralization Tanks
2 Converted Equalization Tank to a Diffused Air Strippers
Up Grade Existing Neutralization Tank
New Flocculation Basin
Two Existing Primary Clarifiers
Existing Gravity Thickener
Existing Sludge Holding Tank
1 Existing Filter Press
New Air Emission Control
Vapor Phase Adsorption
Exhaust Stack
Blowdown Off-Site disposal
New Carbon Regeneration Units
New/Converted Carbon Storage
Recycle Stream
1 Existing Thickener
1 New/Converted Carbon Sludge Mixing/Holding Tank
2 Existing Secondary Clarifiers
Fresh PAC Make-up
2 Existing Aeration Tanks
New Effluent Tank
New GAC Units (24 units)
New RO Units
New Brine Storage Tank
Filtration (4 units)

FIGURE 16

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-1F

CIBA-GEIGY WASTEWATER TREATMENT PLANT TREATMENT OF CONTAMINATED GROUNDWATER ONLY TO NON-DETECTABLE LEVELS

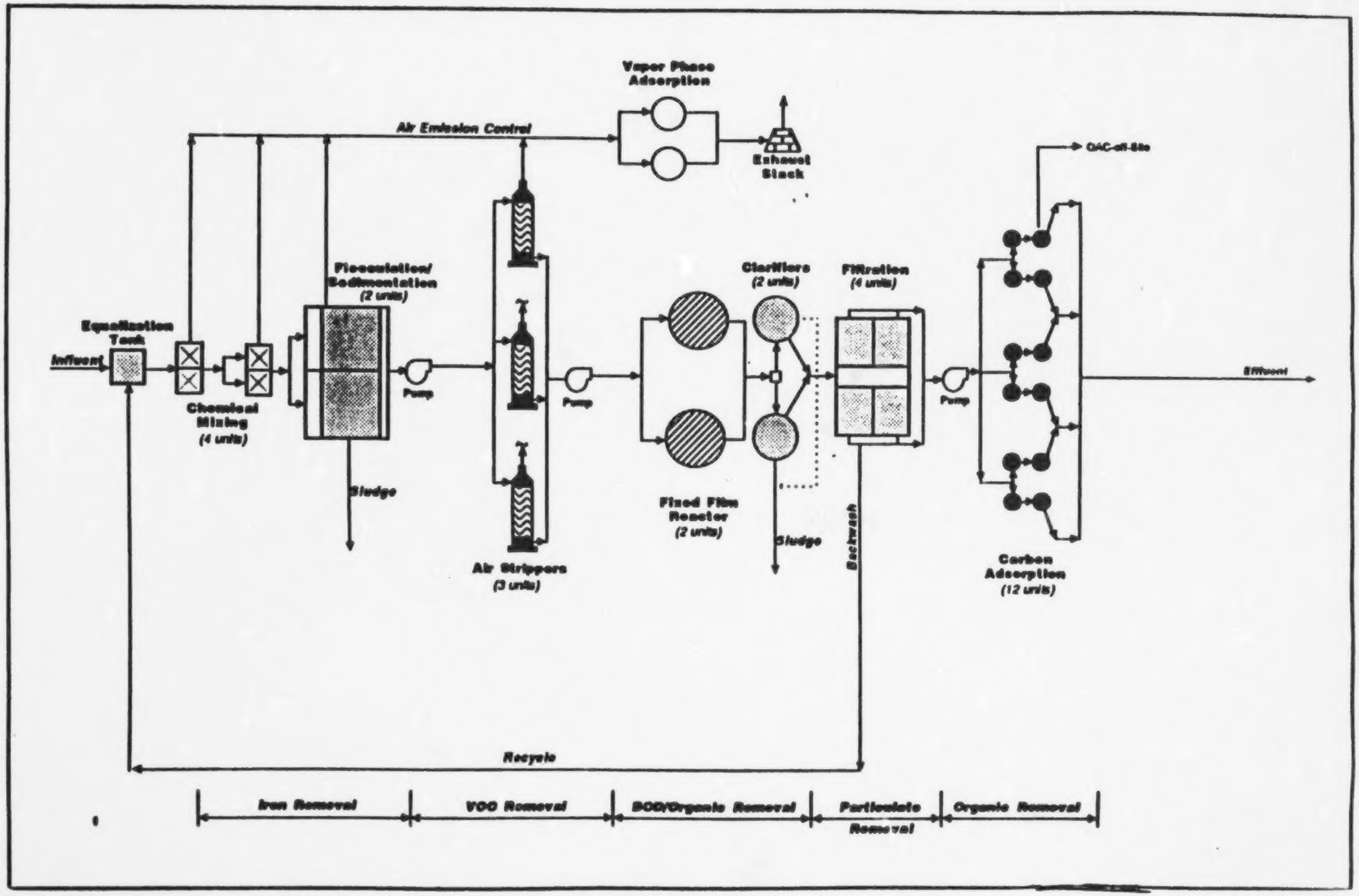
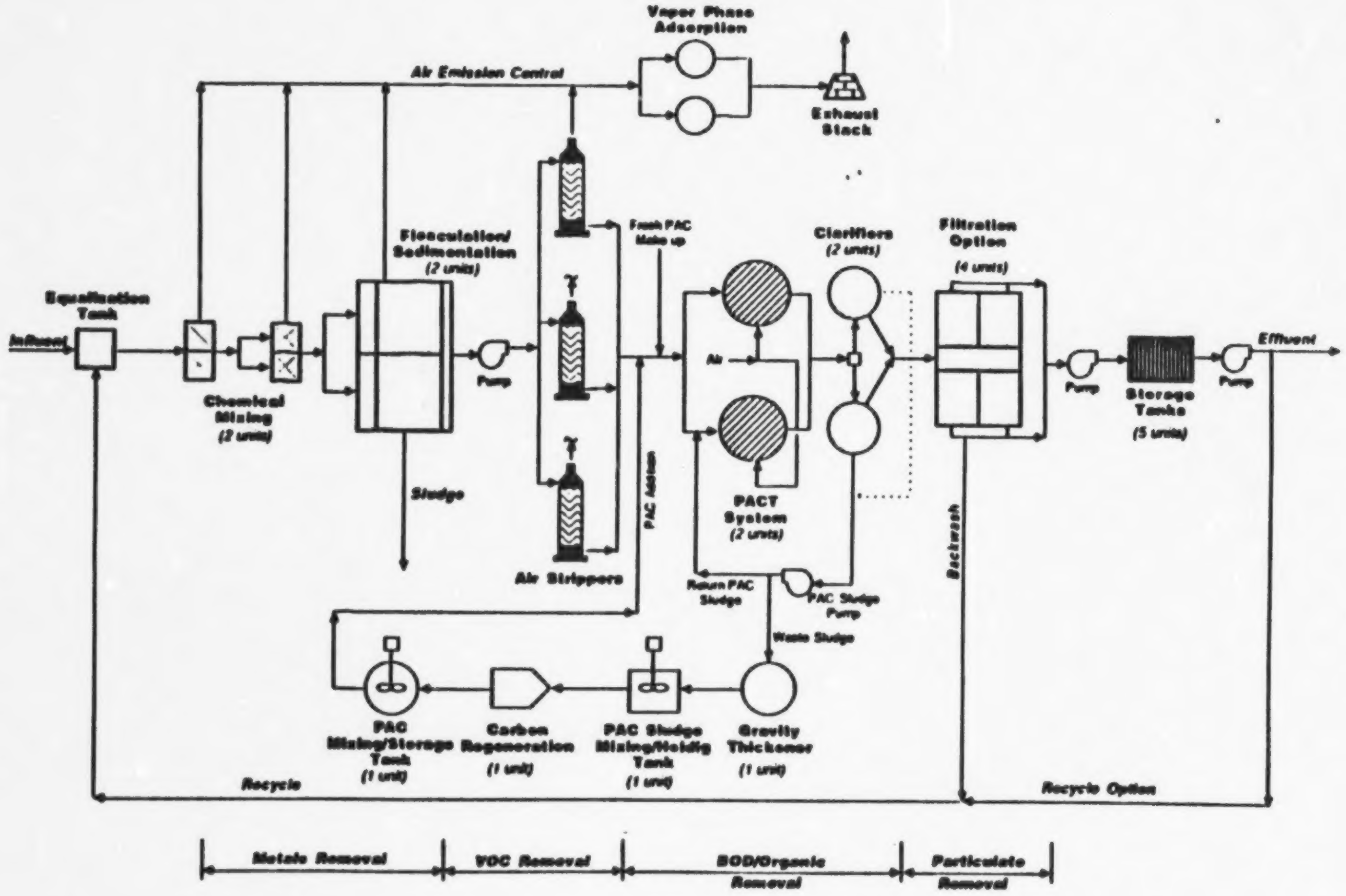

Influent
Equalization Tank
Chemical Mixing (4 units)
Flocculation/ Sedimentation (2 units)
Sludge
Pump
Air Emission Control
Air Strippers (3 units)
Pump
Vapor Phase Adsorption
Exhaust Stack
Fixed Film Reactor (2 units)
Clarifiers (2 units)
Sludge
Filtration (4 units)
Backwash
Pump
Carbon Adsorption (12 units)
GAC-off-Site
Effluent
Recycle
Iron Removal
VOC Removal
BOD/Organic Removal
Particulate Removal
Organic Removal

FIGURE 17

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-3A

NEW PHYSICAL/CHEMICAL TREATMENT PLANT WITH DISCHARGE TO THE ATLANTIC OCEAN


Influent
Equalization Tank
Chemical Mixing (2 units)
Flocculation/ Sedimentation (2 units)
Sludge
Pump
Air Emission Control
Vapor Phase Adsorption
Exhaust Stack
Air Strippers
Fresh PAC Make up
PAC Addition
Air
PACT System (2 units)
Clarifiers (2 units)
Return PAC Sludge
PAC Sludge Pump
Waste Sludge
Gravity Thickener (1 unit)
PAC Sludge Mixing/Holdig Tank (1 unit)
Carbon Regeneration (1 unit)
PAC Mixing/Storage Tank (1 unit)
Filtration Option (4 units)
Backwash
Pump
Storage Tanks (5 units)
Pump
Effluent
Recycle
Recycle Option
Metals Removal
VOC Removal
BOD/Organic Removal
Particulate Removal

Note: Process assumes influent BOD of 60 mg or less.

FIGURE 18

COMPONENT 3 - REMEDIAL ALTERNATIVE GT- 2B

NEW BIOLOGICAL TREATMENT PLANT WITH DISCHARGE TO THE ATLANTIC OCEAN

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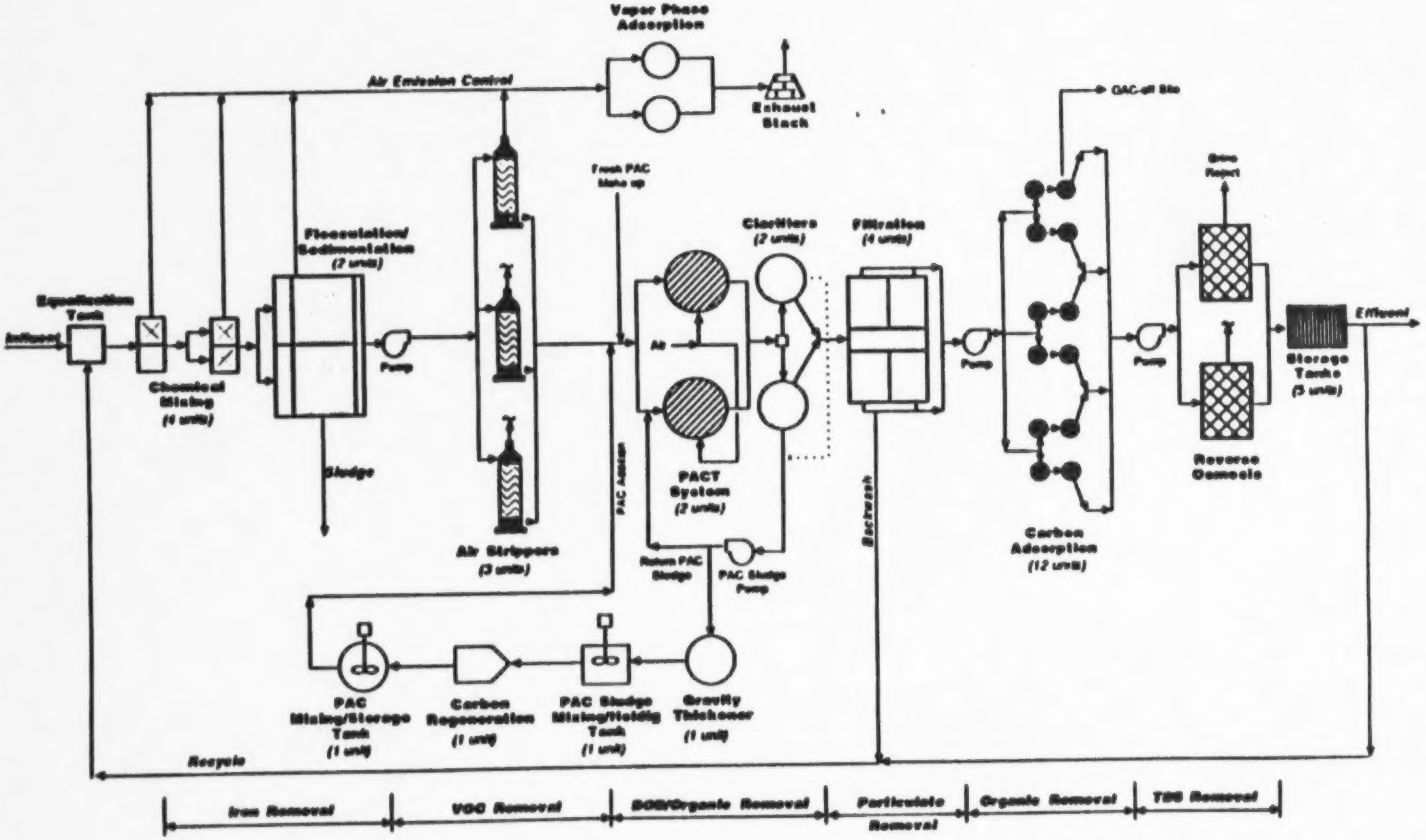
Influent
Equalization Tank
Chemical Mixing (4 units)
Flocculation/ Sedimentation (2 units)
Sludge
Pump
Air Emission Control
Air Strippers (3 units)
Vapor Phase Adsorption
Exhaust Stack
Fresh PAC Make up
PAC Addition
Air
PACT System (2 units)
Return PAC Sludge
PAC Sludge Pump
Clarifiers (2 units)
Filtration (4 units)
Backwash
Pump
Carbon Adsorption (12 units)
GAC-off Site
Pump
Brine Reject
Reverse Osmosis
Storage Tanks (5 units)
Effluent
PAC Mixing/Storage Tank (1 unit)
Carbon Regeneration (1 unit)
PAC Sludge Mixing/Holding Tank (1 unit)
Gravity Thickener (1 unit)
Recycle
Iron Removal
VOC Removal
BOD/Organic Removal
Particulate Removal
Organic Removal
TDS Removal

FIGURE 19

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-3C

NEW BIOLOGICAL TREATMENT PLANT WITH DISCHARGE TO THE TOMS RIVER OR UPPER SAND AQUIFER

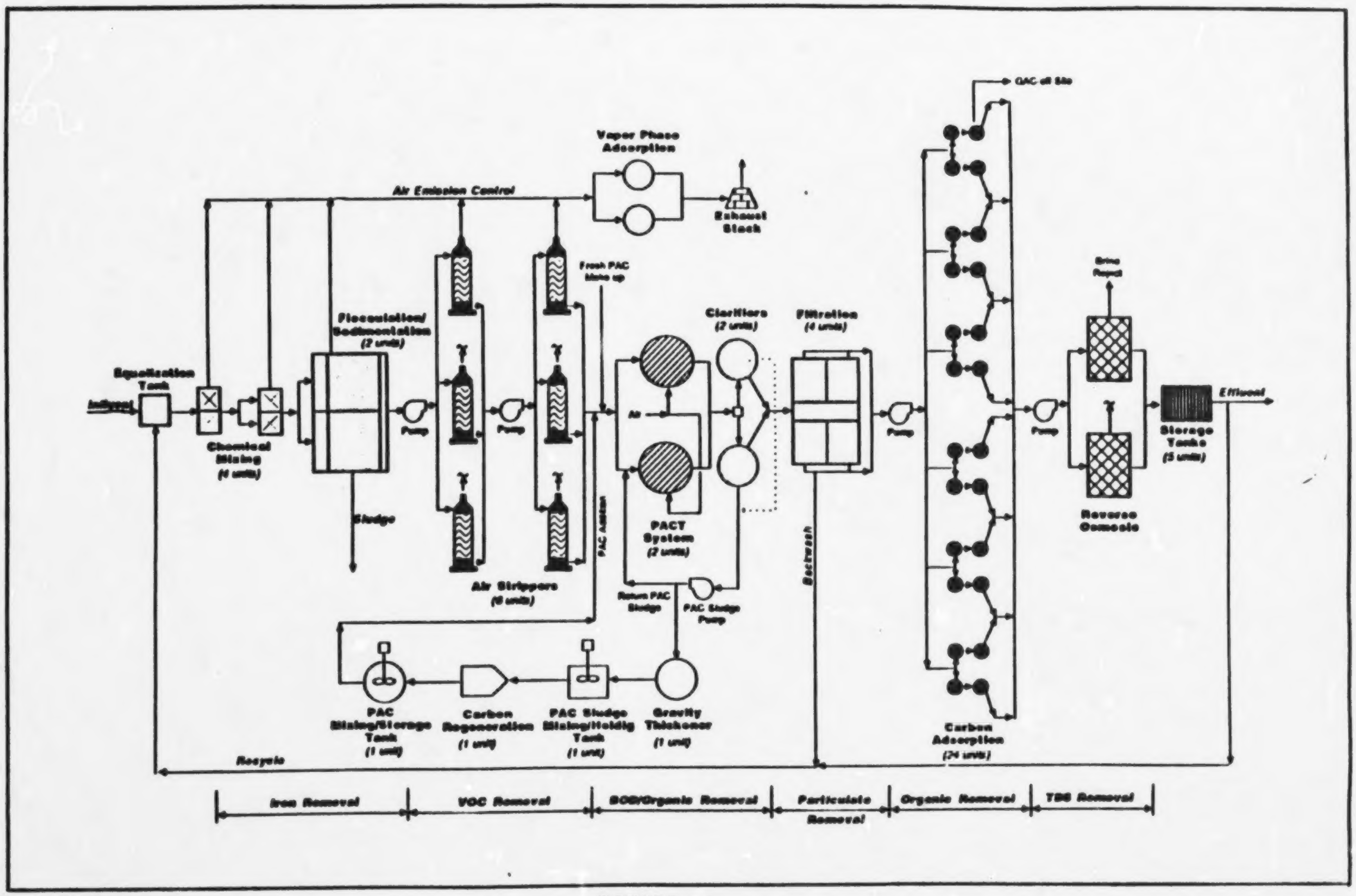
Influent
Equalization Tank
Chemical Mixing (4 units)
Flocculation/ Sedimentation (2 units)
Sludge
Pump
Air Strippers (6 units)
Pump
Air Emission Control
Vapor Phase Adsorption
Exhaust Stack
Fresh PAC Make up
PAC Addition
Air
PACT System (2 units)
Return PAC Sludge
PAC Sludge Pump
Clarifiers (2 units)
Filtration (4 units)
Backwash
Pump
Carbon Adsorption (24 units)
GAC off Site
Pump
Brine Reject
Reverse Osmosis
Storage Tanks (5 units)
Effluent
PAC Mixing/Storage Tank (1 unit)
Carbon Regeneration (1 unit)
PAC Sludge Mixing/Holdig Tank (1 unit)
Gravity Thickener (1 unit)
Recycle
Iron Removal
VOC Removal
BOD/Organic Removal
Particulate Removal
Organic Removal
TDS Removal

FIGURE 20

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-3D

NEW BIOLOGICAL TREATMENT PLANT WITH TREATMENT TO NON-DETECTABLE LEVELS

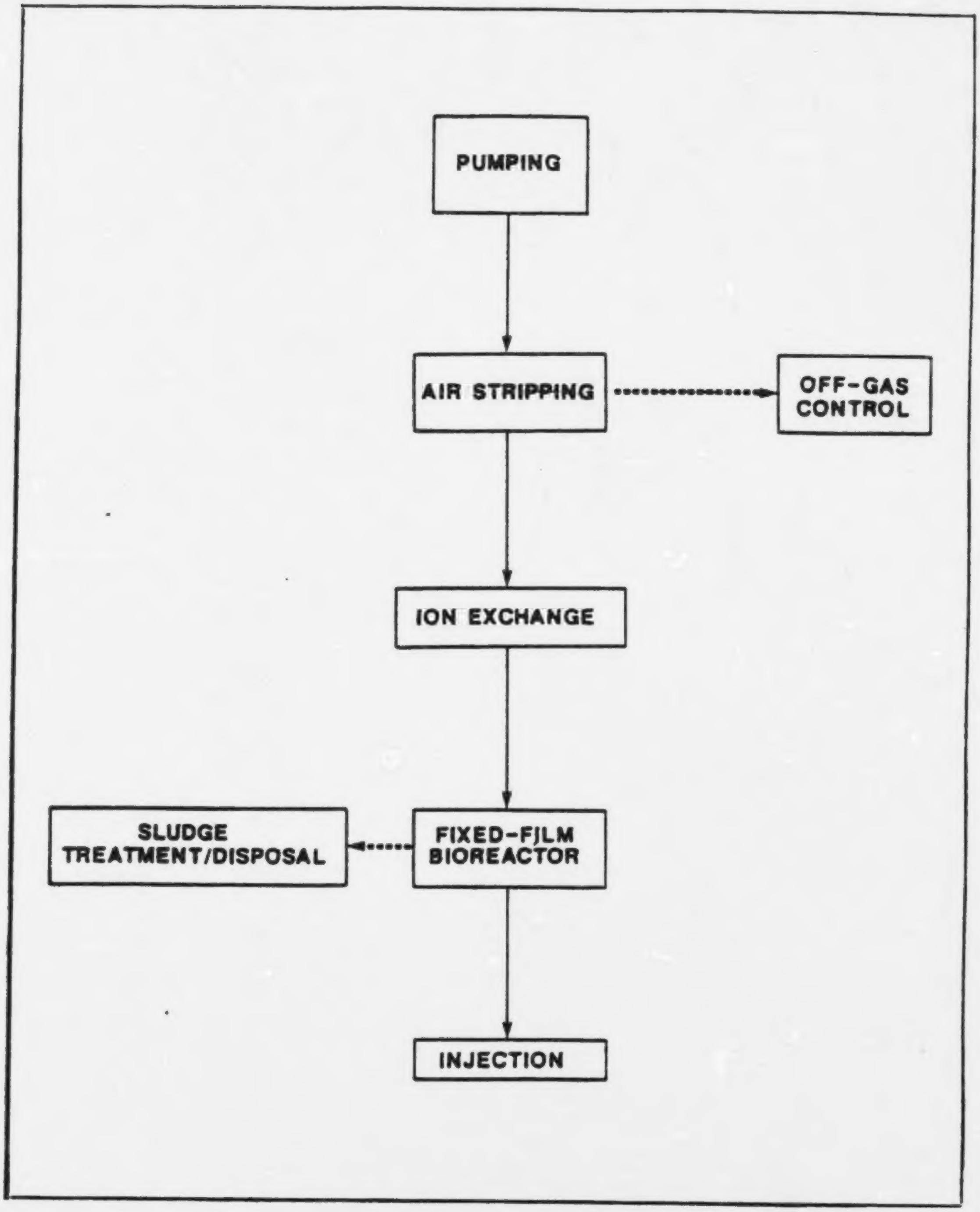
PUMPING
AIR STRIPPING
OFF-GAS CONTROL
ION EXCHANGE
SLUDGE TREATMENT/DISPOSAL
FIXED-FILM BIOREACTOR
INJECTION

FIGURE 21

COMPONENT 3 - REMEDIAL ALTERNATIVE GT-4

IN SITU BIORECLAMATION SYSTEM

APPENDIX A

AVERAGE AND MAXIMUM CONCENTRATIONS OF PRIORITY POLLUTANTS IN VARIOUS ENVIRONMENTAL MEDIA

			Groundwater				Surface Water				Surface Soil				Subsurface Soil				Sediment				Air			
		Koc Value	(ug/L)				(ug/L)				(ug/kg)				(ug/kg)				(ug/kg)				(ug/m3)			
Chemical	CAS No.	ml/g	Min(1)	Max(2)	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq
VOLATILES																										
Benzene	71-43-2	83	0.81	3700	882.75	94/621	2.5	60	26.45	10/25									86.0	2250.9	787.65	4/12	1.5	3.19	2.26	12/28
Chlorobenzene	108-90-7	330	0.91	26000	1325.56	170/629	35	330	82.31	8/25	7	750	398.40	2/125	4.3	32000	3161.02	15/94	20.5	4837.15	2152.26	6/12	2.2	16.5	7.28	13/28
Chloroform	67-66-3	31	0.64	4400	272.32	3/130	6.4	130	68.55										77.9	3625.44	1277.47	5/12	6.3	15.1	9.68	7/28
1,2-Dichloroethane	107-06-2	14	6	700	136.10	5/612																				
1,1-Dichloroethene	75-35-4	65	4.3	21	11.08	6/612																				
1,2-Dichloropropane	78-87-5	51	9	30	15.92	6/344										8.9	8.90	1/89								
Ethylbenzene	100-41-4	1100	1.3	3115	306.63	84/612									5.7	15000	4765.88	13/89								
Toluene	108-88-3	300	1	14000	2998.47	88/629					11	4500	1135.46	4/125	5.7	100000	14260.38	25/94		12.96	12.96	1/12				
Trans-1,2-Dichloroethene	540-59-0	59	1	1300	91.89	127/612	6	41	26.35	6/25									13.5	304.36	147.99	4/12				
1,1,1-Trichloroethane	71-55-6	152	3	60	28.62	5/612						7.2	7.20	1/125						322.5	322.50	1/12				
1,1,2,2-Tetrachloroethane	79-34-5	118	3	49	27.62	12/629										50	50.00	1/94		6.75	6.75	1/12				
Tetrachloroethene	127-18-4	364	0.57	12000	813.25	142/612	15	130	55.09	9/25	6	550	185.24	5/125	9	39000	11673.58	7/94	33.74	4782.8	2481.56	6/12				
Trichloroethene	79-01-6	126	0.5	25000	1386.38	103/612	18	520	142.60	11/25									93.99	5706.75	1935.43	8/12	2.4	58	21.20	14/28
Vinyl Chloride	75-01-4	57	4	69	15.57	7/513																				
Total Xylenes	1330-20-7	240	8	44	17.38	6/382						170	170.00	1/125	24	67000	14141.13	16/89	107.5	293.49	213.76	3/12				
Acetone	67-64-1	2.2	5	74500	2270.84	109/330													190.39	413.06	301.74	2/12				
2-Butanone	78-93-3	4.5		335	335.00	1/330					15	58	34.89	7/125	18	730	104.50	12/55								
Carbon Disulfide	75-15-0	54	5	129	15.96	11/330																				
Chloromethane	74-87-3	35	13	290	142.96	3/234																				
2-Hexanone	591-78-6		6	14	8.70	4/330									40	3100	976.00	5/50								
Methylene Chloride	75-09-2	8.8	3.3	200	47.57	20/574									10	6300	970.00	17/44	86.51	652.2	230.01	4/12				
4-Methyl-2-Pentanone	108-10-1		5	13	7.17	5/330									4.9	2800	1233.73	4/30								
Styrene	100-42-5											45	45.00	1/125												
SEMIVOLATILES																										
Aniline	62-53-3		8	8820	1202.00	16/330					1700	1800	1750.00	2/125												
Azobenzene	103-33-3			10	10.00	1/37																				
Benzoic Acid	65-85-0		4	1000	602.00	2/307																				
Benzyl Alcohol	100-51-6		12	3800	1338.00	3/330																				
Di-N-Butylphthalate	84-74-2	170000		1.0	1.00	1/288					1800	4500	2916.36	11/55	410	4600	2377.5	4/39								
Bis(2-Chloroethyl)Ether	111-44-4	13.9		13	13.00	1/288																				
4-Chloroaniline	106-47-8		10	17	13.37	2/288																				
2-Chloronaphthalene	91-58-7		13	19	16.24	2/288									670	5000	1887.5	4/39								
2-Chlorophenol	95-57-8		12	108	48.00	4/314																				
4-Chloro-3-Methylphenol	59-50-7			12	12.00	1/308																				
1,2-Dichlorobenzene	95-50-1	1700	1.3	10000	651.26	101/629	14	45	24.21	5/25	2500	5100	3795.95	3/125	1.8	120000	20180.80	13/44								
1,3-Dichlorobenzene	541-73-1	1700	3	130	31.16	12/329																				
1,4-Dichlorobenzene	106-46-7	1700	2.4	140	28.40	18/329									2000	23000	10366.70	3/44								
Bis(2-Ethylhexyl)Phthalate	117-81-7		18	520	81.94	16/330					430	8700	2378.38	6/125	650	18000	3043.00	8/39								
Hexachloroethane	67-72-1	20000		14	14.00	1/404																				
Naphthalene	91-20-3		2.9	920	121.75	46/616					2600	4200	3408.10	2/125	3900	120000	20491.70	12/39								
4-Methylphenol	106-44-5	300(3)	35	83	64.50	2/313																				
4-Nitroaniline	100-01-6			34	34.00	1/370																				
Nitrosodimethylamine	62-75-9	0.1		30	30.00	1/430																				
Nitrobenzene	98-95-3	36	5	39000	5298.23	30/616		10	10.00	1/18		390	390.00	2/125	1300	1800	1550.00	2/44								
Di-N-Octyl Phthalate	117-84-0		16	24	20.00	2/305																				

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APPENDIX A (continued)

AVERAGE AND MAXIMUM CONCENTRATIONS OF PRIORITY POLLUTANTS IN VARIOUS ENVIRONMENTAL MEDIA

Chemical	CAS No.	Rec Value ml/g	Groundwater (ug/L) Min(1)	Max(2)	Mean	Freq	Surface Water (ug/L) Min.	Max.	Mean	Freq	Surface Soil (ug/kg) Min.	Max.	Mean	Freq	Subsurface Soil (ug/kg) Min.	Max.	Mean	Freq	Sediment (ug/kg) Min.	Max.	Mean	Freq	Air (ug/m3) Min.	Max.	Mean	Freq
Phenol	108-95-2	14.2	12	456	215.78	6/313																				
1,2,4-Trichlorobenzene	120-82-1	9200	10	4100	312.67	47/507		18	18.00	1/10	420	6500	3110.01	7/125	420	130000	34651.46	14/89								
2,4,5-Trichlorophenol	95-95-4	89													21.5	3800	966.13	4/35								
2-Methylphenol	95-48-7	500(3)	14	632	323.00	2/313																				
Anthracene	120-12-7	14000									330	12000000	2001836.79	12/125	700	5500	3087.50	8/39								
Butyl Benzyl Phthalate	85-68-7										1300	6300	3766.60	6/55		940	940	1/39								
Fluoranthene	206-44-0	38000									500	77000	17949.58	6/125	980	2200	1590.00	2/39								
Pyrene	129-00-0	38000		80	80.00	1/37					500	55000	21000.00	4/125		2000	2000.00	1/39								
Phenanthrene	85-01-8	14000									370	45000	8661.28	6/125	520	79000	23845.63	16/89								
Chrysene	218-01-9	200000									700	35000	12233.37	3/125		800	800.00	1/39								
Benzo(b)Fluoranthene	205-99-2	550000									980	50000	15915.53	4/125		570	570.00	1/39								
Benzo(k)Fluoranthene	207-08-9	550000									980	60000	21093.33	3/125		600	600.00	1/39								
Benzo(a)Pyrene	50-32-8	5500000									830	29000	14914.50	2/70												
Indeno(1,2,3cd)Pyrene	193-39-5	1600000										520	520.00	1/70												
Benzo(ghi)Perylene	191-24-2	1600000										360	360.00	1/70												
PESTICIDES																										
4,4-DDT	50-29-3	243000									6.1	300	34.22	29/125												
4,4-DDE	72-55-9	4400000									1	10	6.20	9/125												
Heptachlor Epoxide	1024-57-3	220									22	340	173.70	4/125												
Endosulfan II	33213-65-9										110	9000	3442.01	5/55												
Dieldrin	60-57-1	1700										6	6.00	1/55												
Chlordane	57-74-9	140000										80	80.00	1/55												
Aroclor 1016	12674-11-2	530000(4)										30	30.00	1/55												
Aroclor 1221	11104-28-2	530000(4)										80	80.00	1/55												
Aroclor 1232	11141-16-5	530000(4)										80	80.00	1/55												
Aroclor 1242	53469-21-9	530000(4)										30	30.00	1/55												
Aroclor 1248	12672-29-6	530000(4)										30	30.00	1/55												
Aroclor 1254	11097-69-1	530000(4)										80	80.00	1/55												
Aroclor 1260	11096-82-5	530000(4)										80	80.00	1/55												
INORGANICS																										
Aluminum	7429-90-5		200	38000	3402.85	147/253		300	300.00	1/13	2.26E+05	5.06E+07	4.77E+06	125/125	5.05E+05	5.20E+07	1.05E+07	50/50	200000	6.10E+05	3.03E+05	4/6				
Antimony	7440-36-0		34	63	48.69	3/253					1.98E+04	5.70E+04	4.72E+04	5/125	6.70E+03	4.00E+04	1.87E+04	3/53								
Arsenic	7440-38-2		11.3	16	13.33	4/400					6.10E+03	6.50E+04	1.53E+04	17/125	6.20E+03	1.61E+05	5.40E+04	12/135								
Barium	7440-39-3		25	395	91.99	31/410						1.22E+05	1.22E+05	1/125												
Beryllium	7440-41-7		5	18	12.52	4/171																				
Cadmium	7440-43-9		5	345	19.90	72/410					1.10E+03	2.00E+04	8.98E+03	3/125	1.10E+01	7.50E+05	7.80E+04	10/85								
Calcium	7440-70-2		6.8	138500	20300.55	141/410		14000	14000.00	2/13	2.26E+06	2.03E+07	9.73E+06	10/125	3.26E+06	1.95E+07	8.20E+06	23/50								
Chromium	7440-47-3		3	318	37.82	150/400					5.40E+03	4.87E+05	2.54E+05	86/125	3.80E+01	1.80E+06	3.94E+05	73/135								
Cobalt	7440-48-4		6	59	30.77	12/253																				
Copper	7440-50-8		21	560	92.10	162/472					1.50E+04	4.44E+06	6.86E+05	36/125	3.10E+01	1.80E+06	6.19E+05	69/103		5.00E+04	5.00E+04	1/6				
Iron	7439-89-6		340	1600000	49720.38	260/400	400	1100	761.00	5/13	5.15E+05	1.10E+08	7.05E+06	125/125	2.38E+05	5.00E+07	9.79E+06	50/50	580000	1.60E+06	1.38E+06	6/6				
Lead	7439-92-1		1	389	46.55	233/400					2.90E+03	6.50E+04	1.30E+04	80/125	1.20E+02	3.21E+05	9.57E+04	63/135	6100	1.50E+05	5.80E+04	3/6				

APPENDIX A (continued)

AVERAGE AND MAXIMUM CONCENTRATIONS OF PRIORITY POLLUTANTS IN VARIOUS ENVIRONMENTAL MEDIA

			Groundwater				Surface Water				Surface Soil				Subsurface Soil				Sediment				Air			
			(ug/L)				(ug/L)				(ug/kg)				(ug/kg)				(ug/kg)				(ug/m3)			
Chemical	CAS No.	Koc Value mL/g	Min(1)	Max(2)	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq
Phenol	108-95-2	14.2	12	495	213.70	4/313																				
1,2,4-Trichlorobenzene	120-82-1	9200	10	4100	312.67	47/507		10	10.00	1/10	420	6500	3110.01	7/125	420	130000	34631.46	14/89								
2,4,5-Trichlorophenol	95-95-4	89													21.5	3800	966.13	4/55								
2-Methylphenol	95-48-7	500(3)	14	632	323.00	2/313																				
Anthracene	120-12-7	14000									350	12000000	2001836.79	12/125	700	5500	3087.50	8/39								
Butyl Benzyl Phthalate	85-68-7										1300	6300	3766.60	6/55		940	940	1/39								
Fluoranthene	206-44-0	38000									500	77000	17949.50	6/125	500	2200	1390.00	2/39								
Pyrene	129-00-0	38000		80	80.00	1/37					500	59000	21000.00	4/125		2000	2000.00	1/39								
Phenanthrene	85-01-8	14000									370	45000	8663.28	6/125	520	75000	23845.63	16/89								
Chrysene	218-01-9	200000									700	35000	12233.37	3/125		800	800.00	1/39								
Benzo(b)Fluoranthene	205-99-2	550000									980	58000	13919.93	4/125		570	570.00	1/39								
Benzo(k)Fluoranthene	207-08-9	550000									980	60000	21093.33	3/125		600	600.00	1/39								
Benzo(a)Pyrene	50-32-8	5500000									830	29000	14914.90	2/70												
Indeno(1,2,3cd)Pyrene	193-39-5	1600000										520	520.00	1/70												
Benzo(ghi)Perylene	191-24-2	1600000										360	360.00	1/70												
PESTICIDES																										
4,4-DDT	50-29-3	243000									6.1	330	34.22	29/125												
4,4-DDE	72-55-9	4400000									1	10	6.28	9/125												
Heptachlor Epoxide	1024-57-3	220									22	340	173.70	4/125												
Endosulfan II	33213-65-9										110	9800	3442.04	5/55												
Dieldrin	60-57-1	1700										6	6.00	1/55												
Chlordane	57-74-9	140000										80	80.00	1/55												
Aroclor 1016	12674-11-2	530000(4)										50	50.00	1/55												
Aroclor 1221	11104-28-2	530000(4)										80	80.00	1/55												
Aroclor 1232	11141-16-5	530000(4)										80	80.00	1/55												
Aroclor 1242	53469-21-9	530000(4)										50	50.00	1/55												
Aroclor 1248	12672-29-6	530000(4)										50	50.00	1/55												
Aroclor 1254	11097-69-1	530000(4)										80	80.00	1/55												
Aroclor 1260	11096-82-5	530000(4)										80	80.00	1/55												
INORGANICS																										
Aluminum	7429-90-5		290	38000	3402.85	147/253		500	500.00	1/13	2.26E+05	5.06E+07	4.77E+06	125/125	5.05E+05	5.20E+07	1.05E+07	50/50	200000	6.10E+05	3.0E+05	4/6				
Antimony	7440-36-0		34	63	48.69	3/253					3.90E+04	5.70E+04	4.72E+04	3/125	6.70E+03	4.00E+04	1.87E+04	3/53								
Arsenic	7440-38-2		11.3	16	13.33	4/408					6.10E+03	6.50E+04	1.53E+04	17/125	6.20E+03	1.61E+05	5.40E+04	12/135								
Barium	7440-39-3		25	395	91.99	31/410						1.80E+05	1.80E+05	1/125												
Beryllium	7440-41-7		5	10	12.52	4/171																				
Cadmium	7440-43-9		5	345	19.90	72/410					3.10E+03	2.00E+04	8.90E+03	3/125	1.10E+01	7.50E+05	7.80E+04	10/85								
Calcium	7440-70-2		0.8	138900	20500.95	141/410		14000	14000.00	2/13	2.26E+06	2.03E+07	9.73E+06	10/125	3.26E+06	1.95E+07	8.20E+06	23/50								
Chromium	7440-47-3		3	318	37.82	190/408					5.40E+03	4.87E+06	2.54E+05	86/125	3.80E+01	1.80E+06	3.94E+05	73/135								
Cobalt	7440-48-4		6	59	30.77	12/253																				
Copper	7440-50-8		21	560	92.18	162/472					1.30E+04	4.44E+06	6.86E+05	36/125	3.10E+01	1.80E+06	6.19E+05	69/103		5.00E+04	5.0E+04	1/6				
Iron	7439-89-6		340	1600000	49720.38	260/408	400	1100	781.00	5/13	5.15E+05	1.10E+08	7.03E+06	125/125	2.30E+05	5.00E+07	9.79E+06	50/50	580000	1.60E+06	1.3E+06	6/6				
Lead	7439-92-1		1	389	46.58	233/408					2.98E+03	6.58E+04	1.38E+04	88/125	1.20E+02	3.21E+05	9.57E+04	63/135	6100	1.50E+05	5.80E+04	3/6				

APPENDIX A (continued)

AVERAGE AND MAXIMUM CONCENTRATIONS OF PRIORITY POLLUTANTS IN VARIOUS ENVIRONMENTAL MEDIA

			Groundwater				Surface Water				Surface Soil				Subsurface Soil				Sediment				Air			
		Rac Value	(ug/L)				(ug/L)				(ug/kg)				(ug/kg)				(ug/kg)				(ug/m3)			
Chemical	CAS No.	ml/g	Min(1)	Max(2)	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq	Min.	Max.	Mean	Freq
Lithium	7439-93-2		10	85	24.60	17/115																				
Magnesium	7439-95-4		1060	145000	27225.85	73/413					3.44E+06	3.58E+07	1.39E+07	11/125	5.00E+06	3.04E+07	1.44E+07	17/50								
Manganese	7439-96-5		10	4695	441.35	155/410		20	20.00	1/13	8.30E+03	2.91E+05	4.15E+04	77/125	7.60E+03	4.75E+05	1.03E+05	46/50								
Mercury	7439-97-6		0.2	12	1.10	47/400					1.10E+02	3.00E+05	3.59E+04	61/125	1.20E+02	2.40E+05	2.35E+04	66/135								
Nickel	7440-02-0		21	642	76.09	73/410					2.20E+04	4.60E+04	3.06E+04	12/125	4.00E+01	2.00E+05	1.94E+04	19/103								
Potassium	7440-09-7		4100	137000	9000.85	61/410																				
Selenium	7782-49-2		6	31	14.34	3/253					7.10E+03	7.90E+03	7.35E+03	2/125	1.00E+03	5.00E+03	3.07E+03	7/85								
Silver	7440-22-4														5.40E+03	3.70E+04	1.69E+04	3/135								
Sodium	7440-23-5		4000	250000	29792.85	127/410	6000	16000	8444.17	6/13																
Tin	7440-31-5		30	80	71.16	3/216					2.00E+04	1.10E+05	6.40E+04	8/125												
Vanadium	7440-62-2		29	233	74.71	7/273					2.70E+04	1.41E+05	5.96E+04	21/125	3.30E+04	2.10E+05	7.59E+04	17/50								
Zinc	7440-66-6		20	3660	312.00	240/400					1.00E+04	1.77E+06	2.14E+05	47/125	3.00E+01	6.46E+05	1.12E+05	48/103		2.50E+05	2.50E+05	1/6				

NOTES:

(1) Minimum value of detected concentrations
(2) Maximum concentrations
(3) Rac value for Cresol, CAS No. 1319-77-3, used.
(4) Rac for Polychlorinated Biphenyls, CAS No. 1336-36-3, used.

Appendix B

LOCATION SPECIFIC ARARS

Location	Requirement	Prerequisite(s)	Citation	Potential Applicability
Critical Habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species including consultation with the Department of the Interior	Determination of endangered species or threatened species	Endangered Species Act of 1973 (16 USC 1531 *et seq.*) 50 CFR Part 200, 50 CFR Part 402	Alternatives GD-1, GD-2A and GD-2B
Wetland	Action to minimize destruction, loss, or degradation of wetlands	Wetland as defined by Executive Order 11990 Section 7	Executive Order 11990 Protection of Wetlands (40 CFR 6, Appendix A)	Alternatives GE-2, and GE-3
Within Flood Plain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action that will occur in a floodplain, i.e., lowlands and relatively low areas adjoining inland and coastal waters and other flood prone areas	Executive Order 11988 Protection of Floodplains, (40 CFR 6, Appendix A)	Component 2 all Discharge Alternatives
Historic project owned or controlled by Federal Agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks	Property included or eligible for the National Registry of Historic Places	National Historic Preservation Act Section 106 (16 USC 470 *et seq.*) 36 CFR Part 800	Components 1, 2 and 3 all Remedial Alternatives
Within coastal zone	Conduct activities in manner consistent with approved State management programs	Activities affecting the coastal zone including lands thereunder and adjacent shorelands	Coastal Zone Management Act (16 U.S.C. Section 1451 *et seq.*)	Components 1, 2 and 3 all Remedial Alternatives

APPENDIX B

ACTION-SPECIFIC ARARs

Actions	Requirements	Prerequisites	Citation	Potenial Applicability
Direct discharge of treament system effluent	Use of best available technology (BAT) economically achievable is required to control toxic and nonconventional pollutants. Use of best conventional pollutant control technology (BCT) is required to control conventional pollutants. Technology-based limitations may be determined on a case-by-case basis.		40 CFR 122.44(a)	Alternatives GT-1A to GT-1D Alternatives GT-2A and GT-2B
	Applicable Federally approved State water quality standards must be complied with. These standards may be in addition to or more stringent than other Federal standards under the CWA.		40 CFR 122.44 and State regulations approved under 40 CFR 131	
	Applicable Federal water quality critia for the protection of aquatic life must be complied with when environmental factors are being considered.		50 FR 30784 (July 29, 1985)	
	The discharge must conform to applicable water quality requirements when the discharge affects a state other than the certifying state.		40 CFR 122.44(d)	
	The discharge must be consistent with the requirements of a Water Quality Management plan approved by EPA water (WA |208(6).			
	Discharge limitations must be established for all toxic pollutants that are or may be discharged at levels greater than that which can be achieved by technology-based standards.		40 CFR 122.44(e)	
	Develop and implement a BMP program and incorporate in the NPDES permit to prevent the release of toxic constituents to surface waters.		40 CFR 125.100	

APPENDIX B (continued)

ACTION-SPECIFIC ARARs

Action b/	Requirements	Prerequisites	Citation
Direct discharge of treatment system effluent (cont.)	The BMP program must:		40 CFR 125.104
	• Establish specific procedures for the control of toxic and hazardous pollutant spills.		
	• Include a prediction of direction, rate of flow, and total quantity of toxic pollutants where experience indicates a reasonable potential for equipment failure.		
	• Assure proper management of solid and hazardous waste in accordance with regulations promulgated under RCRA.		
	Discharge must be monitored to assure compliance. Discharge will monitor:		
	• The mass of each pollutant		40 CFR 122.44(i)
	• The volume of effluent		
	• Frequency of discharge and other measurements as appropriate.		
	Approved test methods for waste constituents to be monitored must be followed. Detailed requirements for analytical procedures and quality controls are provided.		
	Sample preservation procedures, container materials, and maximum allowable holding times are prescribed.		40 CFR 136.1-136.4

APPENDIX B (continued)
ACTION-SPECIFIC ARARs

Actions b/	Requirements	Prerequistes	Citation
Direct discharge of treatment system effluent (cont.)	Permit application information must be submitted including a description of activities, listing of environmental permits, etc.	On-site discharges to surface waters are exempt from procedural NPDES permit requirements. c/ Off-site discharges would be required to apply for and obtain an NPDES permit.	40 CFR 122.21
	Monitor and report results as required by permit (minimum of at least annually).		40 CFR 122.44(i)
	Comply with additional permit conditions such as:		40 CFR 122.41(i)
	° Duty to mitigate any adverse effects of any discharge; and		
	° Proper operation and maintenance of treatment systems.		
Direct discharge to ocean	Discharges causing "unreasonable degradation of the marine environment" are not permitted.		40 CFR 125.123(b)
	Determination of whether a discharge will cause reasonable degradation of the marine environment is based on consideration of:		40 CFR 125.122
	° Quantity, composition, or persistence of pollutants to be discharged.		
	° Potential transport of pollutants by biological, chemical or physical processes.		
	° Composition and vulnerability of exposed communities.		

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c/ Section 121 of SARA exempts on-site CERCLA activities from obtaining permits. However, the substantive requirements of a permit must be met.

APPENDIX B (continued)
ACTION-SPECIFIC ARARs

Actions b/	Requirements	Prerequisites	Citation
Direct discharge to ocean (cont.)	• Importance of the receiving water to spawning, migratory paths, and surrounding biological community.		
	• Existence of specific aquatic sites.		
	• Impact on human health and commercial fishing.		
	Comply with the limiting permissible concentrations (LPGs) at the mixing zone boundary that are established in the permit.		40 CFR 125.123(d)(1)
	Permit applicants may be required to submit the following: analyses of chemical constituent of the discharge and the affected biological community, appropriate bioassays necessary to determine LPCs, a description of the facility and treatment process, and evaluations of alternative disposal options.		40 CFR 125.124
	Permit applicants shall be required to comply with a monitoring program specified in the permit. This program must assess the impact of the discharge on water, sediment, and biological quality.		40 CFR 125.123
Discharge to POTW d/	Pollutants that pass-through the POTW without treatment, interfere with POTW operation, or contaminate POTW sludge are prohibited.		40 CFR 403.5
	Specific prohibitions preclude the discharge of pollutants to POTWs that:		
	• Create a fire or explosion hazard in the POTW;		
	• Are corrosive (pH<5.0);		

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d/ Same regulations apply regardless of whether remedial action discharges into the sewer or trucks waste to

APPENDIX B (continued)

ACTION-SPECIFIC ARARs

Action b/	Requirements	Prerequisites	Citation
Discharge to POTW (cont.)	• Obstruct flow resulting in interference; • Are discharged at a flow rate and/or concentration that will result in interference; and • Increase the temperature of wastewater entering the treatment plant that would result in interference, but in no case raise the POTW influent temperature above 104°F (40°C).		
	• Discharge must comply with local POTW pretreatment program, including POTW-specific pollutants, spill prevention program requirements, and reporting and monitoring requirements.		40 CFR 403.5 and local POTW regulations
	• RCRA permit-by-rule requirements must be compiled with for discharges of RCRA hazardous wastes to POTWs by truck, rail, or dedicted pipe.		40 CFR 264.71 and 264.72